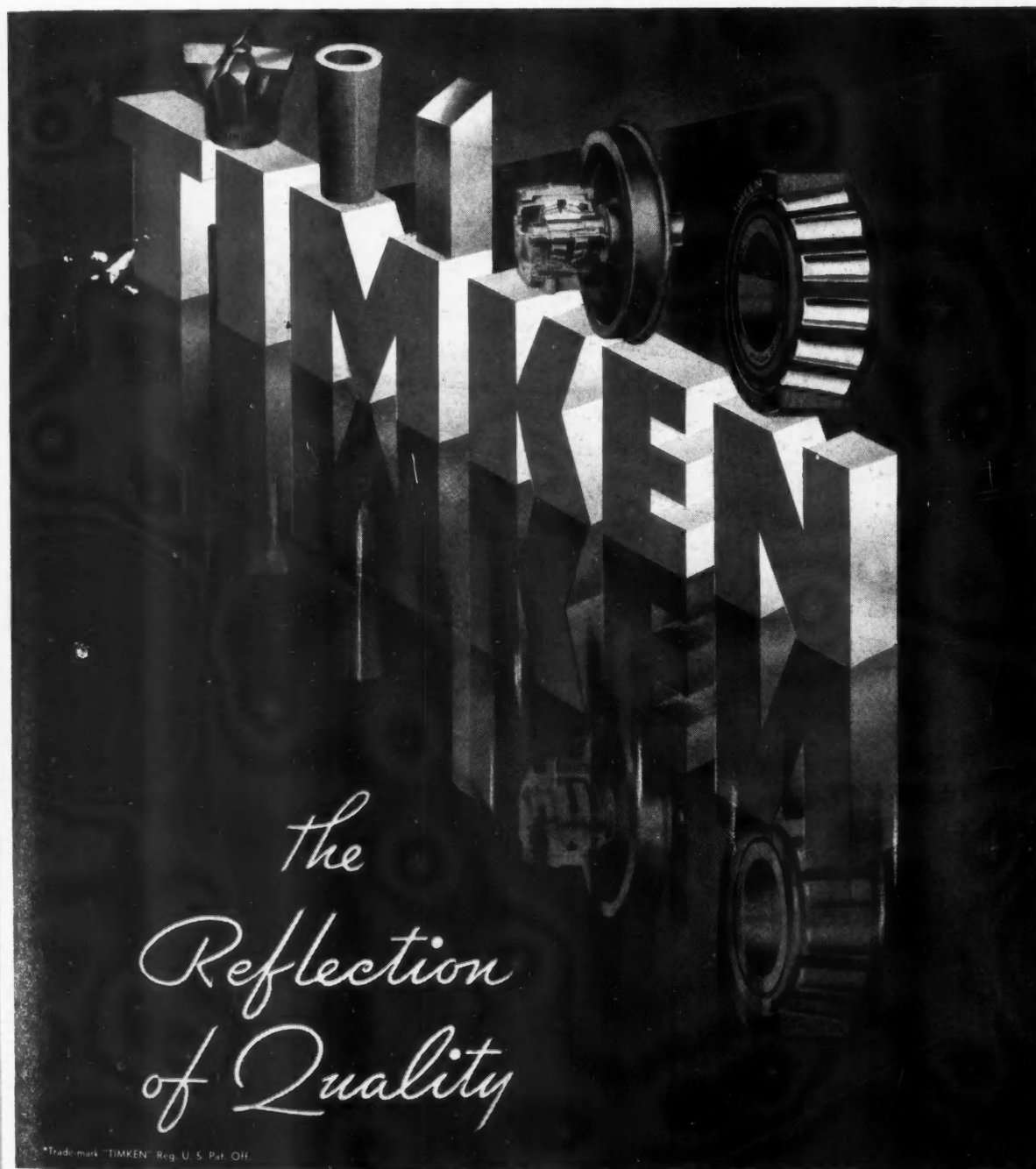


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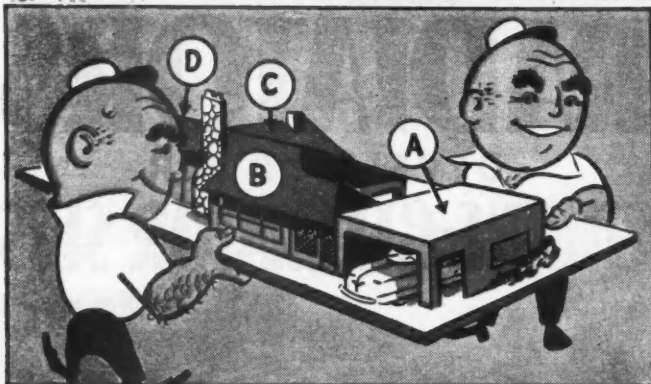
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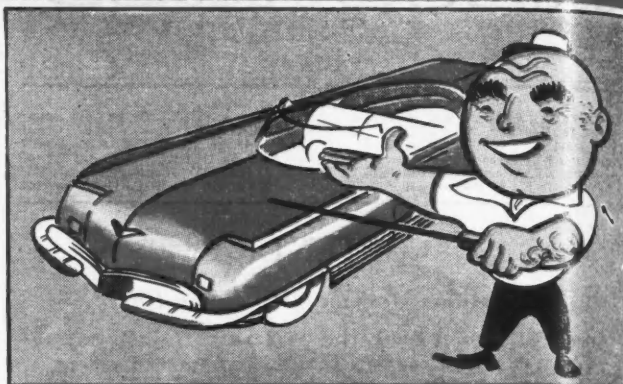
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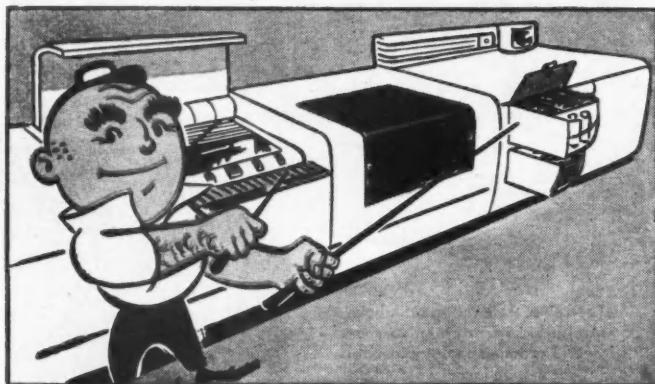
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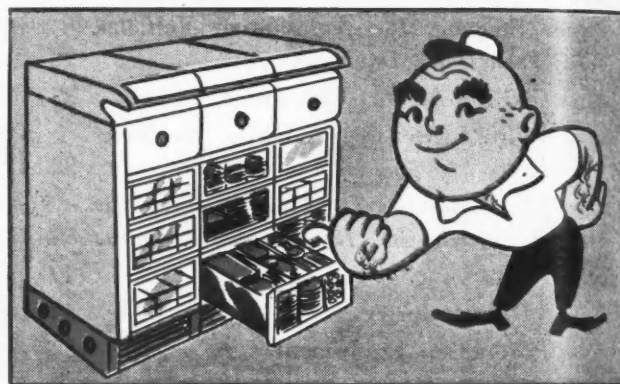
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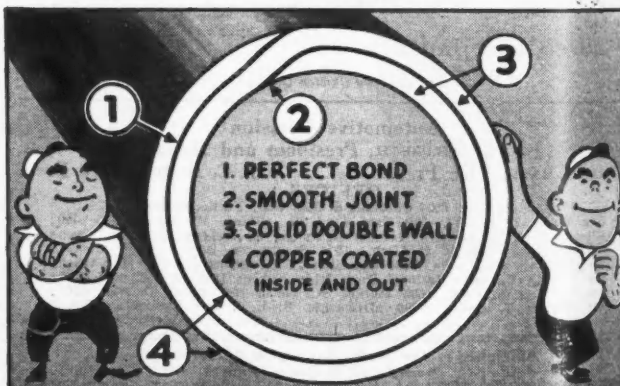
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What IS National Income?

by Julian Chase

THOSE government departments, independent associations and individual economists who play around with that elusive, intangible and much tossed about thing most briefly described as National Income will do a great favor and perform a real service to the rest of us if they will get together in a huddle and come out with an inflexible set of standards of terminology and methods of calculation.

Today there seems, at least to the layman, to be the greatest of confusion in that field. Its heterogeneous products appear too generally to be the results of purely speculative research, conjectural calculation and grasping from the air expressed in what, without elaborate elucidation and explicit definition of terms, are violently contradicting statements, estimates and predictions. And that is so not merely because laymen are laymen. It is due, also and in large measure, to the fact that there are, quite obviously, important differences and divergencies among the experts.

Some years ago, automotive engineers were in much the same situation with respect to their planning and their products. Strong and rugged individualists among them had their own unshakable convictions as to terminology, dimensions, tolerances and what not. But they got together on a give and take basis greatly to the advantage of all concerned including themselves even though they did not come to complete and final agreement on all details in all cases. The economists might well take a leaf out of that chapter in the history of automotive design and save themselves a lot of argument and explanation and us a lot of confusion and misunderstanding.

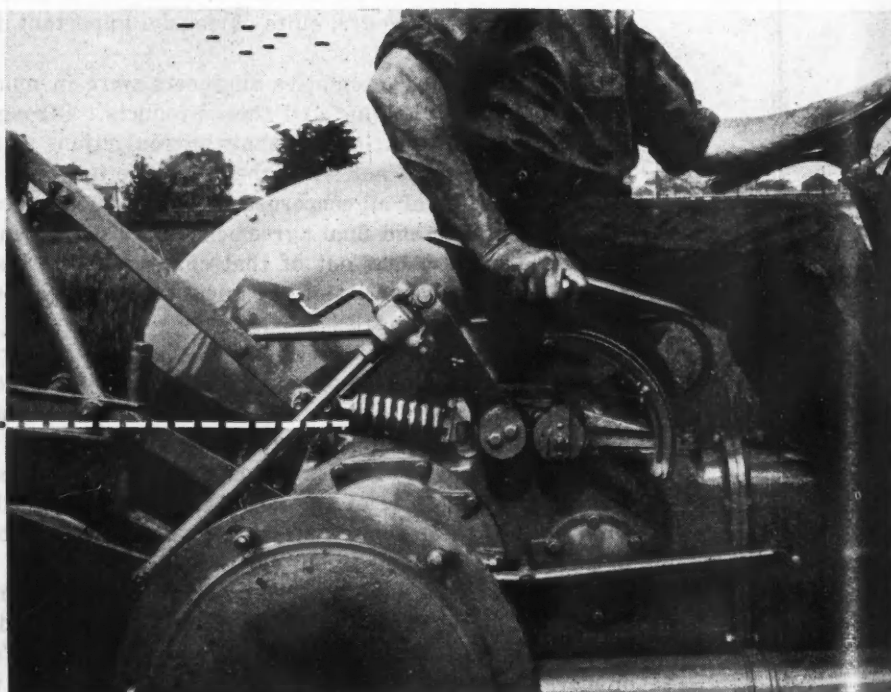
In these days of looking ahead to the postwar period, we have much discussion and prophecy based on and growing out of our hopes and expectations as to how rosy the future will be. How well off financially are we to be and how many jobs will there be for those who need or want them?

In that kind of figuring, the economists start with estimates of national income and the probable size of the labor force. But immediately they disagree as to what each of these factors really is or how it should be calculated. With respect to the former, some stand out for income payments to individuals. Some call the same thing, or something only slightly different, national income paid out. Others set up what they call national income produced as the essential criterion. Still others go for gross national product. And that's not all of it. When two or more agree that some one of these is *sine qua non*, they likely will disagree as to what its components should be and how they should be calculated.

Of course each of these terms could be made to mean something specific and something useful in a uniform way. But until such standardization is brought about confusion will reign among the many and argument will prevail among the few. It would be nice and it is important to have this business simplified so that all of the rest of us will know, without the help of long explanatory footnotes, what the other fellow is talking about when he talks about national income.

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facilities at Muehl-
hausen for making
large springs.

Accomplishments of the Aircraft Industry in 1944

THE American aircraft industry produced 96,369 airplanes during 1944, exceeding 1943's production record by almost 10,500 aircraft. This 1944 record represents an increase of 12 per cent production volume over 1943 when the aircraft industry produced 85,946 airplanes. With a tentative schedule for 1945 of approximately 85,250 airplanes, the past year's achievement of nearly 100,000 airplanes may remain as an all-time world production record. The 1944 production represented a dollar volume estimated at \$21-billion, which maintains the position of aircraft manufacturing as the largest industry in the world.

The past year's volume brings to almost a quarter of a million the total aircraft produced since 1941, of which approximately 232,000 were built since Pearl Harbor. The annual aircraft production for the past four years is as follows:

	Units
1941	19,290
1942	47,873
1943	85,946
1944	96,369
Total	249,478

America's record production compared with that of Great Britain: Since September, 1939, the date of the war's start, the United Kingdom produced 102,609 aircraft to July 1, 1944. Final totals on 1944's production by Great Britain and the United Kingdom are not available as yet, but if production reaches full expectations it will still be only one-third of America's total.

According to the War Production Board, America's output of planes was running four to one ahead of Germany's—and that estimate was made last May. Since then, of course, Germany has lost many of her vital plants in occupied countries and had many of her own ruined by bombing. Japanese production—shortly before the B-29's came on the scene—was even less in proportion to ours. The WPB then estimated Japanese production was only 13 per cent of that of the United States.

To accomplish this greatest aircraft production

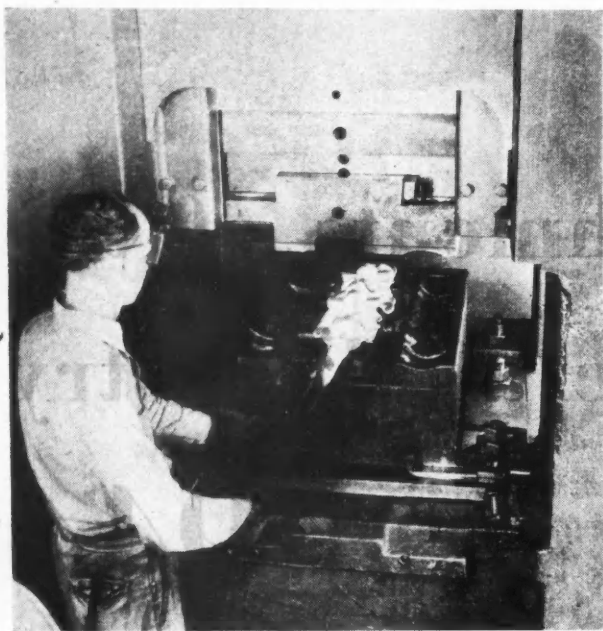
assignment in history, the aircraft industry maintained an average production rate of approximately 8000 airplanes per month or about 11 planes every hour of the day and night during 1944. The past year was marked by an increasing emphasis on production of bigger and more powerful aircraft, the average weight per plane delivered having risen from 8080 pounds to approximately 10,500 pounds during the twelve-month period. Production was concentrated on tactical types—bombers, fighters, naval reconnaissance and transports—in contrast to the earlier period when the aircraft production program was concentrated on trainers.

The record was marked with greater efficiency all along the lines. Indicative of this is the increase in the amount of airframe weight produced per employee rising from 70 pounds in November, 1943, to 96 pounds during the latter part of 1944. In January, 1941, only 21 pounds of airframe weight were produced per employee. Further, the 1944 record was achieved with fewer employees indicative of continued emphasis on increased manpower utilization and improved production methods. From a peak of 2,100,000 employees in the latter part of 1943, employment had dropped to approximately 1,671,000 by November, 1944. These totals include subcontractors.

The increased production efficiency also reflected itself in cost savings. In 1942, a four-engined heavy bomber cost \$500,000 to produce. It's now being turned out for \$250,000. One of the fighter planes used to cost \$70,000. Now it's being built for \$50,000. The super-bombers now flying cost well over \$1,000,000 apiece, but as production and efficiency are increased the price will go down.

Despite the continued high volume, the aircraft industry profits continued to be the lowest of any large war producers. In its latest survey the Securities Exchange Commission reported a net profit after income taxes of only 1.5 per cent on sales for the aircraft

(Turn to page 56, please)



Close-up of Ajax 25-C high speed forging press, rated 2500 tons, used in the experimental production of automobile crankshafts

SUCCESSFUL experimental press forging of automobile crankshafts with counterweights has been accomplished at the Ajax Manufacturing Co. plant in Cleveland on a heavy tonnage high-speed mechanical forging press. Crankshaft dies formerly used in 12,000 and 16,000 lb steam hammers at an important engine plant were adapted to the die space of a 25-C Ajax High Speed forging press by means of suitable shoes or bolsters. The press used was of the type built in a range of sizes for impression-die forging production. Rated at 2500 tons capacity, it was known to be somewhat light for this work, but was the largest available at the time for testing. The stroke is 14 in. with 50 strokes per minute available; the full eccentric main shaft is 18 in. diameter in the main bearings.

One of the crankshaft forgings is shown here along with the dies used during the development. Dies for the counterweighted shaft had only fullering and finish forging impressions. Billet stock is of the same size as for the hammer forging, but during the early trials the length was cut down to $\frac{1}{2}$ or $\frac{2}{3}$ so that results could be observed without seriously overloading the press. In the fullering or rolling impression, it was surprising to find how closely the two full blows of the press approximated the results of the numerous light blows struck by the hammer. The only change necessary

One of the crankshaft forgings produced on the Ajax forging press.

Press Forging

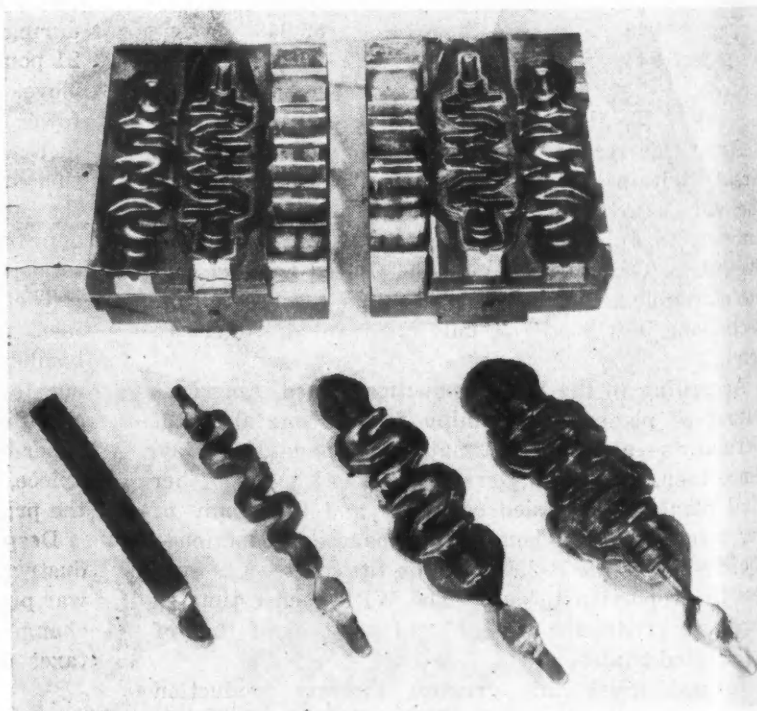
Counterweighted Crankshafts

was to increase the volume of the impressions slightly so as to accommodate the stock when the dies were tight together.

In the finishing impressions, particularly in the counterweight locations, the forgings at first failed to fill out, although the amount of adjacent flash indicated the stock distribution was correct. Die lubricant did not remedy, in fact exaggerated this condition, which indicated that the impressions were "air-locked." Liberal vent holes were drilled in the locations last to fill, resulting in crankshaft forgings filled out perfectly in every detail.

Only three blows were required to produce the large counterweighted shaft. Furthermore, no skill is involved in manipulating for light and heavy blows, as the press stroke is constant. The finish on the forg-

(Turn to page 114, please)



The CG-15A, a 16-place glider.

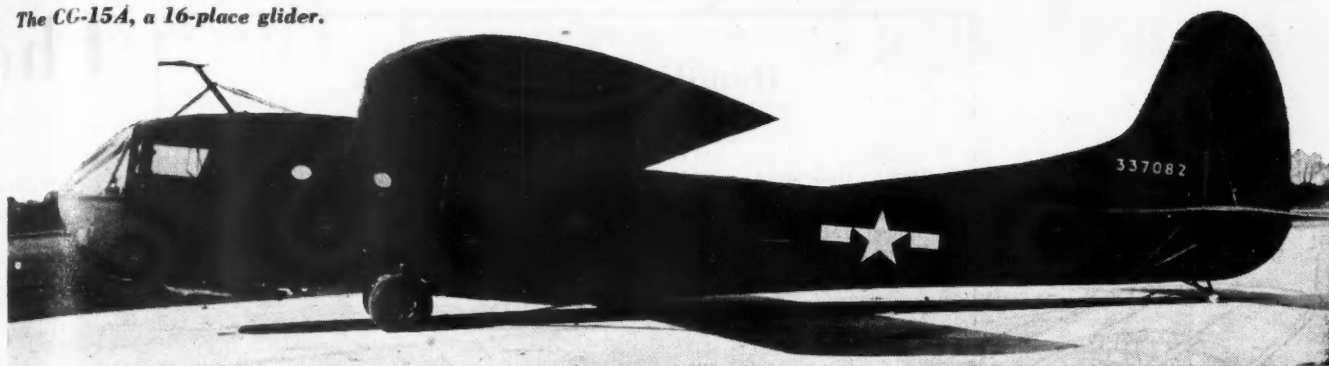


Photo by AAF Air Technical Service Command

New Military Gliders

S AID to be the largest wooden glider ever constructed, having a load capacity of 17,500 lb and a normal wing loading of 21.7 psf, the British Hamilcar needs the most powerful of four-engined bombers to serve as its tug. The Halifax bomber is said to have an excellent operational record in this capacity. Specifications of the Hamilcar and a line drawing showing its constructional details will be found on the next two pages.

One of the youngest members of the U. S. Army Air Forces glider series, born of the battle experience with the CG-4A in spearheading the invasions of Sicily, Burma, Normandy and Holland, is the new CG-15A now going from the production lines of the Waco plant to the fighting fronts of the world. It bears a strong resemblance to the CG-4A, but differs in having a strongly-reinforced nose section, clipped wings, and a landing gear with improved shock-absorbing characteristics. These changes by Waco engineers have upped the useful load of this glider by over 500 lb, increased the maximum towing speed from 150 to 180 mph, and provide better crash protection for the crew. Its 21-ft less wing span makes the CG-15 more suitable for towing by fighter planes. Flaps were added to counteract the effect of the shortened wings on the stalling speed, which approximates that of the CG-4A. A view of the CG-15A and comparative specifications of the four Waco-designed gliders are given on this page.

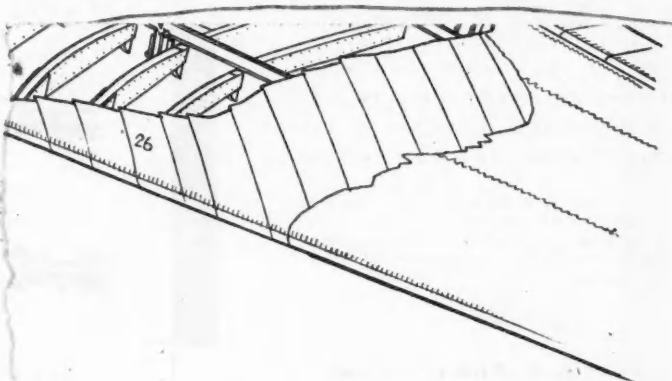
Successfully used in the Normandy and Arnheim battles, the Hamilcar was designed for the transport of heavy military equipment, such as tanks, guns, pontoon bridge material, tractors, bulldozers, etc. It is a high wing monoplane with a nose-opening door, this arrangement having been chosen to ensure that, when lowered onto its skids, armored track vehicles and other types can be driven out directly without needing a special ramp. As a result, vehicles can be unloaded and in action within 15 seconds after the aircraft comes to rest. To assist in this rapid exit, the engine of each vehicle is started and warmed up while the glider is in flight. To prevent harm to the ma-

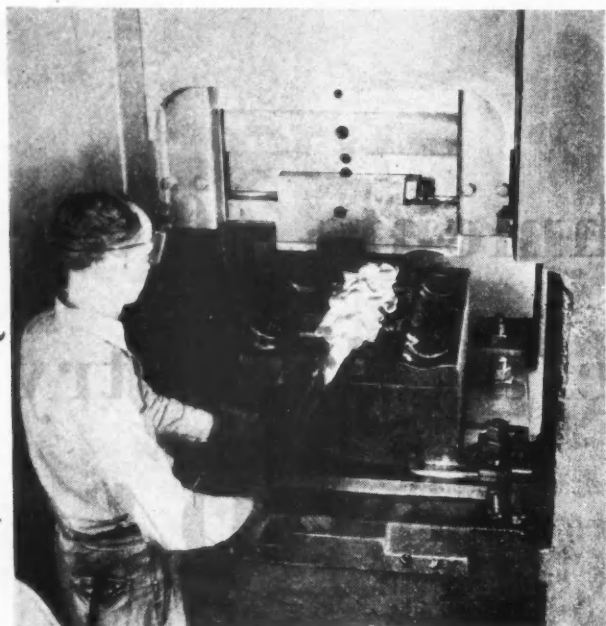
chine by fire, all exhaust pipes have temporary extension pipes leading to the outside of the glider; these disengage automatically as the vehicle moves forward.

The Hamilcar has been designed to land on a wheeled undercarriage and use its momentum, combined with differential wheel braking, to steer itself clear of the actual landing strip. Moreover, immediately it comes to rest the high pressure oil in the chassis shock absorbers is released, allowing them to telescope, so permitting the machine to sink onto its skids and the vehicle or vehicles inside to be driven out at once.

After loading while resting on its skids, the Hamilcar is lifted at the front by two 15-ton hydraulic jacks; the undercarriage is then opened out and the glider lowered until it rests on its landing wheels.

Another design feature of the Hamilcar announced by the Ministry of Aircraft Production in London is the provision of particularly large wing flags which, operated through a pneumatic servo, enable the pilot to control the angle to glide within an exceptionally wide range. Flying controls and instruments are duplicated, one set for each pilot, including complete blind-flying equipment. Pilots have a telephone intercommunication system with one another, with the tug pilot and with the crew of the vehicle or vehicles carried. Pneumatic controls are operated by air pressure stored in high and low pressure air bottles, the high pressure at 1000 psi.





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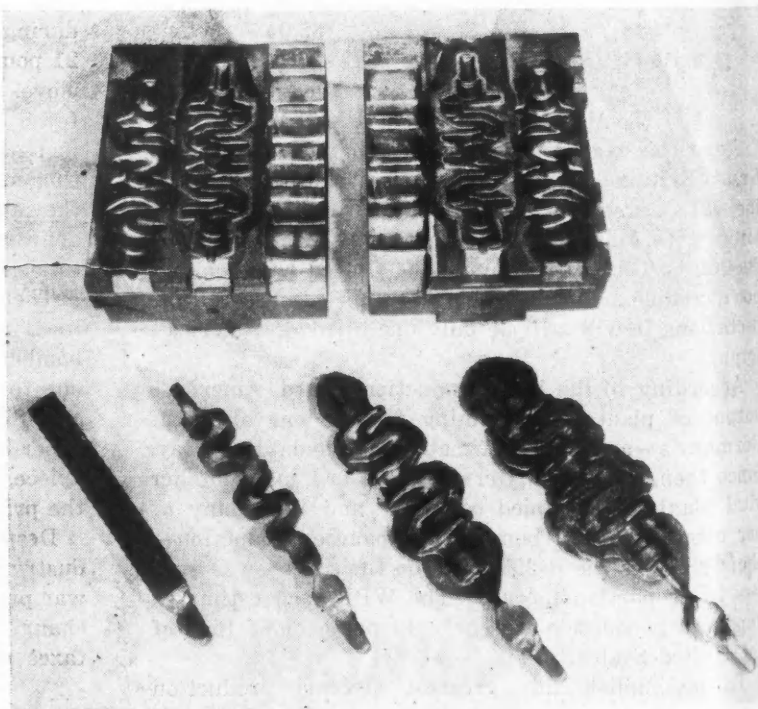
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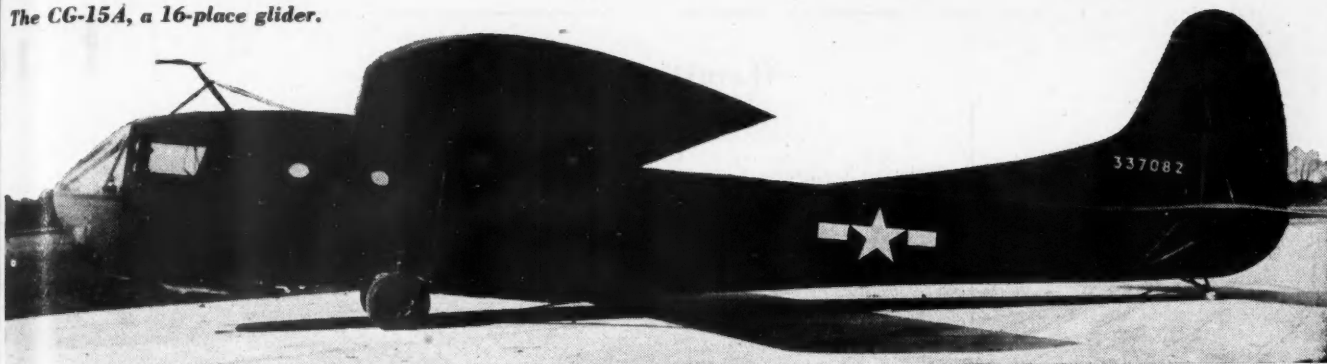


Photo by AAF Air Technical Service Command

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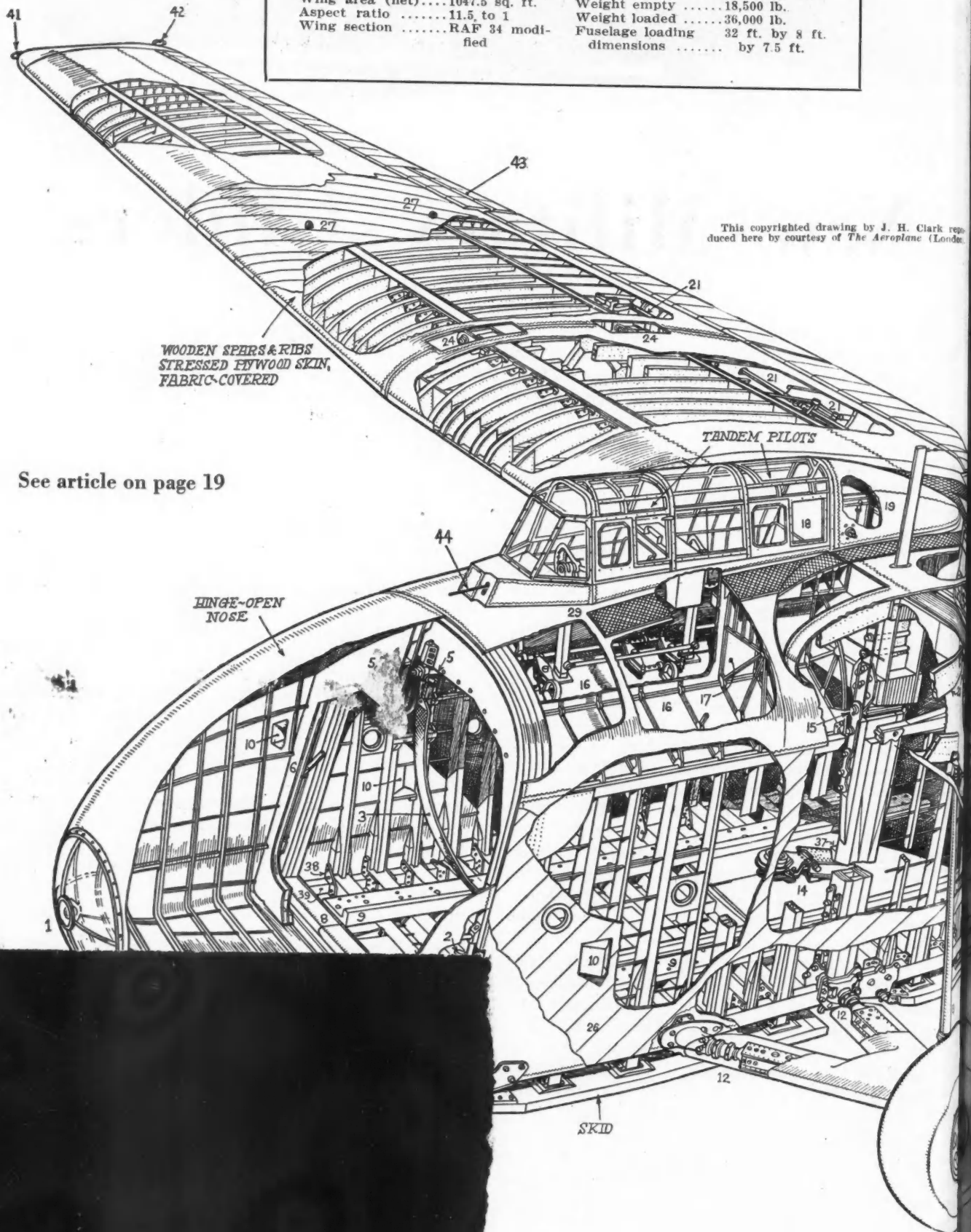
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Hamilcar Specifications

Span	110 ft.	Chord at root.....	18½ ft.
Length	68 ft. 1 in.	Chord at tip.....	8 ft. 9 in.
Height (tail down)...	20 ft. 3 in.	Tailplane span	32 ft. 6 in.
Wing area (gross)...	1657.5 sq. ft.	Tailplane area	250.2 sq. ft.
Wing area (net)....	1047.5 sq. ft.	Weight empty	18,500 lb.
Aspect ratio	11.5 to 1	Weight loaded	36,000 lb.
Wing section	RAF 34 modified	Fuselage loading	32 ft. by 8 ft.
		dimensions	by 7.5 ft.



This copyrighted drawing by J. H. Clark reproduced here by courtesy of The Aeroplane (London)

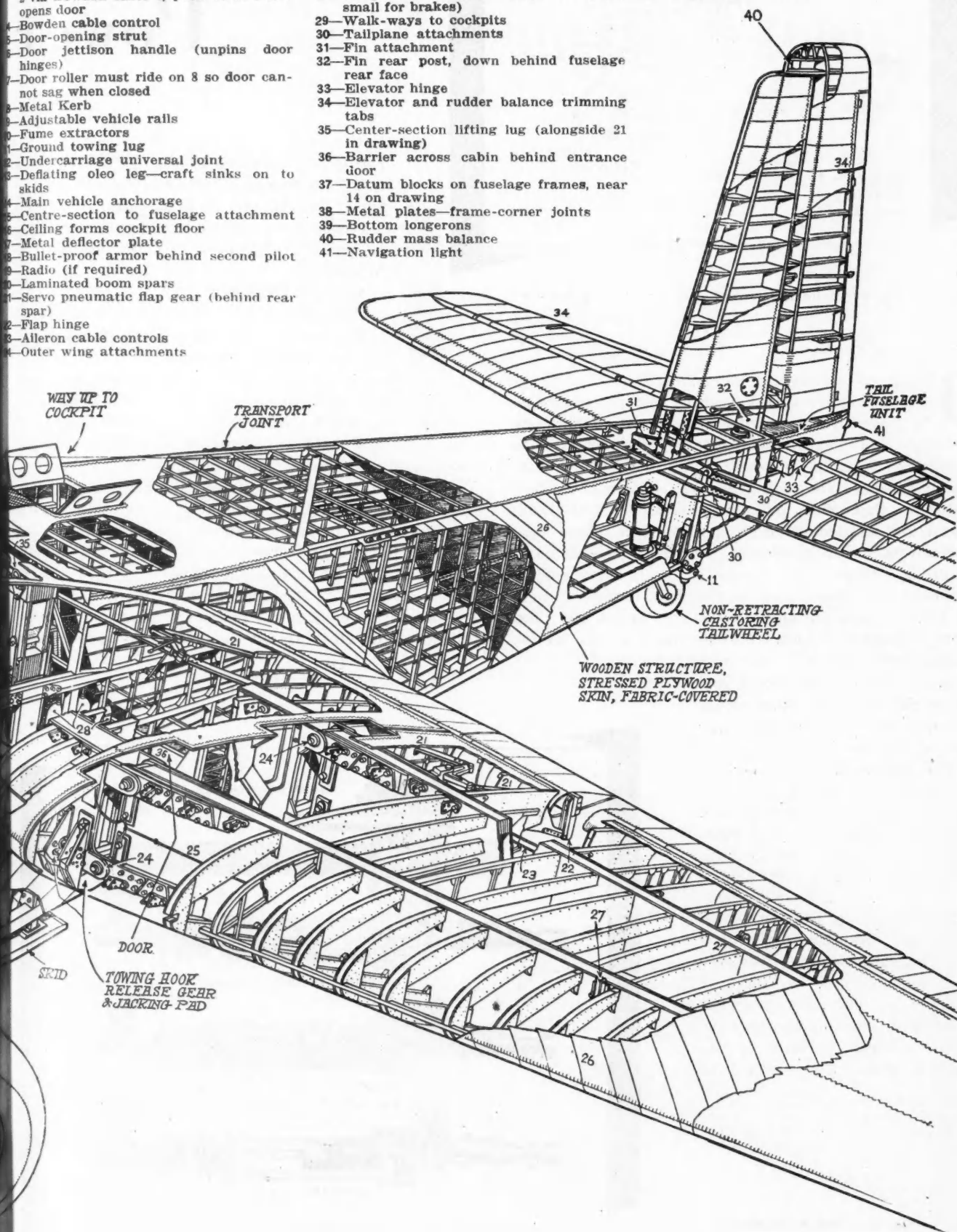
See article on page 19

General Aircraft Hamilcar I

- 1—Landing
- 2—Door opening handles
- 3—Vehicle pushes strap 3 and releases latch 2 via Bowden cable 4, pulls strut 5 and opens door
- 4—Bowden cable control
- 5—Door-opening strut
- 6—Door jettison handle (unpins door hinges)
- 7—Door roller must ride on 8 so door cannot sag when closed
- 8—Metal Kerb
- 9—Adjustable vehicle rails
- 10—Fume extractors
- 11—Ground towing lug
- 12—Undercarriage universal joint
- 13—Deflating oleo leg—craft sinks on to skids
- 14—Main vehicle anchorage
- 15—Centre-section to fuselage attachment
- 16—Ceiling forms cockpit floor
- 17—Metal deflector plate
- 18—Bullet-proof armor behind second pilot
- 19—Radio (if required)
- 20—Laminated boom spars
- 21—Servo pneumatic flap gear (behind rear spar)
- 22—Flap hinge
- 23—Aileron cable controls
- 24—Outer wing attachments

- 25—Electrical bonding
- 26—Diagonal plywood grain
- 27—Lifting lugs
- 28—Air-pressure bottles (large for flaps, small for brakes)
- 29—Walk-ways to cockpits
- 30—Tailplane attachments
- 31—Fin attachment
- 32—Fin rear post, down behind fuselage rear face
- 33—Elevator hinge
- 34—Elevator and rudder balance trimming tabs
- 35—Center-section lifting lug (alongside 21 in drawing)
- 36—Barrier across cabin behind entrance door
- 37—Datum blocks on fuselage frames, near 14 on drawing
- 38—Metal plates—frame-corner joints
- 39—Bottom longerons
- 40—Rudder mass balance
- 41—Navigation light

- 42—Recognition light
- 43—Aileron trimming tab (starboard only)
- 44—Tow-line indicator
- 45—Nose-door windows



Power S

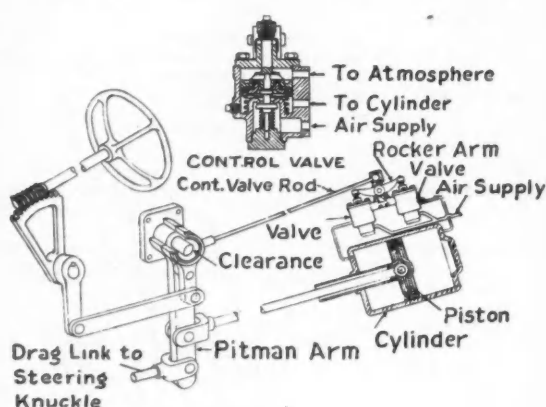


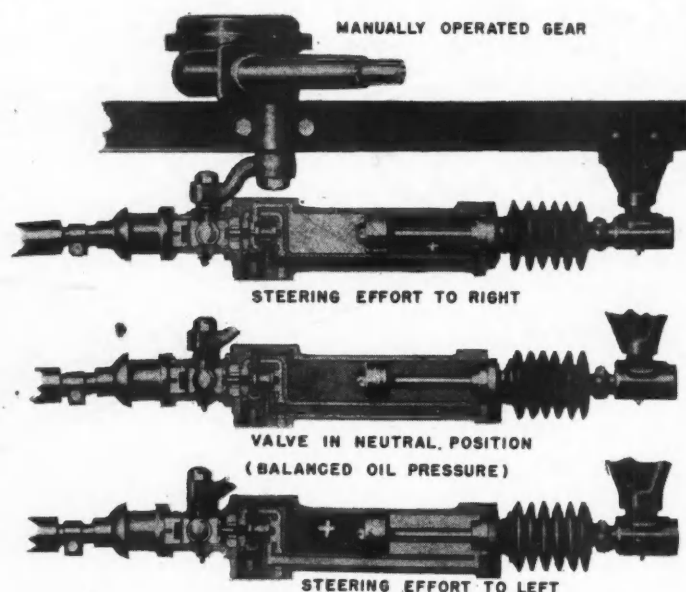
Fig. 1—Bendix Westinghouse air steering booster

THE great variety and increasing number of heavy duty vehicles which have been put into operation in recent years, many of them with front axle loadings that make manual steering impractical, has intensified interest in power steering gears. Fortunately the need for such gears was sufficiently anticipated so that when military and other critical demands for servo-steering mechanisms arose there were commercial units available. The Ordnance Department is using power gears in great numbers in armored cars, tank recovery units and wreckers, some of them of greater horsepower and larger size than ever attempted before. Commercial applications include trucks, buses, road machinery, both agricultural and industrial tractors, snow plows, off-the-road vehicles and many special purpose units.

The patent art on power assisted steering gears for automotive ground vehicles goes back to 1906. Perhaps the first automobile power steering gear to attract attention in this country was a mechanical torque amplifier developed by the Bethlehem Steel Co. Another early gear was the author's first hydraulic unit demonstrated in 1928. A number of vacuum and compressed air steering boosters one with electrical operation of the control valves, appeared in

This article is based on the paper of the same title presented by Mr. Davis in January at the War Engineering-Annual Meeting of the Society of Automotive Engineers.

Fig. 2—Vickers hydraulic steering booster



Europe in the early 1930's. (For details of these developments, see AUTOMOTIVE INDUSTRIES, Dec. 10 and 17, 1932—Ed.)

Power steering gears currently available in the United States may be classified as follows:

Vacuum—Empire.

Compressed Air—Bendix-Westinghouse.

Hydraulic — Vickers, Hub, Ross-Bendix, Saginaw-Bendix, Garrison.

With the exception of the Ross-Bendix and Saginaw-Bendix, these gears are boosters which can be mounted on existing vehicles with minor or no modification of their manual steering gears. Fig. 1 illustrates the Bendix-Westinghouse mechanism. The two control valves, mounted on the cylinder, are operated in a manner which, broadly, is common to most of the gears. Between the linkage operating the valves and that leading to the front wheels is a slight amount of play. The taking up of this play actuates a valve which applies pressure to the appropriate end of the power cylinder, thus causing the piston to follow up the movement of the steering wheel. When the driver stops

Steering for Automotive Vehicles

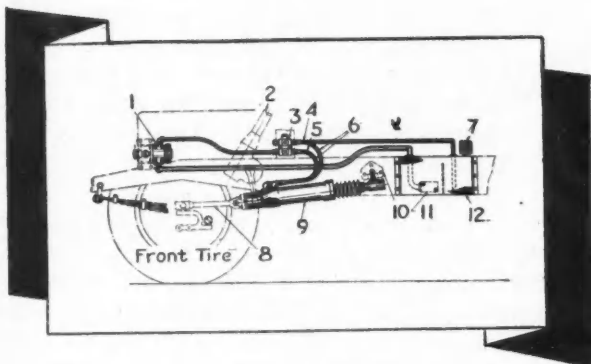


Fig. 3—Typical application of Vickers power steering booster (S3-277 Series)

- | | |
|-----------------------------------|--|
| 1—Engine driven Vickers vane pump | 7—Air filter |
| 2—Steering column | 8—Drag link |
| 3—Overload relief valve | 9—Vickers series 53-277 power steering booster |
| 4—Return | 10—Frame bracket |
| 5—Pressure | 11—Oil filter |
| 6—Flexible hose connections | 12—Oil tank |

turning the wheel, the piston restores the play in the linkage, bringing the valve back to neutral. In the case of the Bendix-Westinghouse gear, the valve first cuts its end of the cylinder off from the atmosphere, then admits air under pressure. Whatever pressure exists in the cylinder also reacts against the valve and, through the control linkage, against the driver's hands.

The Vickers hydraulic gear, Fig. 2, also utilizes a small amount of play between the Pitman arm and the drag-link to operate the valve, but because the valve is integral with the power cylinder, the linkage is quite simple. Fig. 3 illustrates a typical application. There is no oil reaction against the valve, and up to the maximum output of the power cylinder, substantially the only effort required of the driver is to overcome friction in the steering gear and the resistance of a light centering spring. Power is furnished by a vane pump producing up to 1000 psi.

The Ross-Bendix Gear, Fig. 4, and the

Saginaw-Bendix Gear, Fig. 5, are basically alike in their manner of operation except that the former uses a cam and lever type of reduction gear and the latter a ball-nut form. In both cases the control valve, shown in three positions in Fig. 6, is mounted at the end of the steering column. When sufficient resistance to steering is encountered the steering post moves endwise a slight amount, this motion being used to actuate the valve. The power cylinder is integral with the steering gear housing and the piston transmits power to the cross shaft through a sliding block.

The Garrison steering booster, Fig. 7, comprises a control valve of the spool type which permits a through flow of oil in the center position. The valve is installed as an integral part of the drag-link (see Fig. 8). The power cylinder is mounted on the front axle and connects to the cross tie rod. Preloaded centering springs of considerable strength maintain the valve in the center position. No hydraulic reaction is provided.

The relation of power steering to manual steering can be readily shown as in Fig. 9. The hand effort is shown as pull in pounds on steering wheel rim and the drag-link pressure is shown as pounds-foot torque. The figures chosen are within a typical range but can

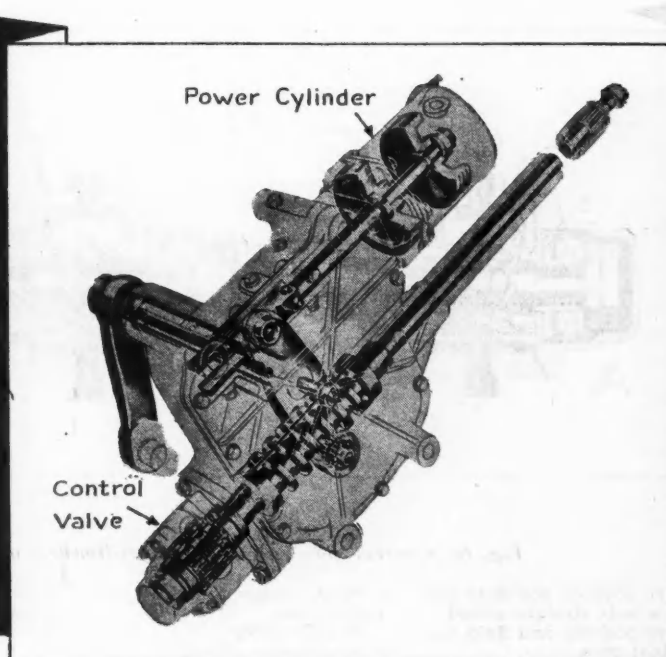


Fig. 4—Ross-Bendix—integral hydraulic steering gear

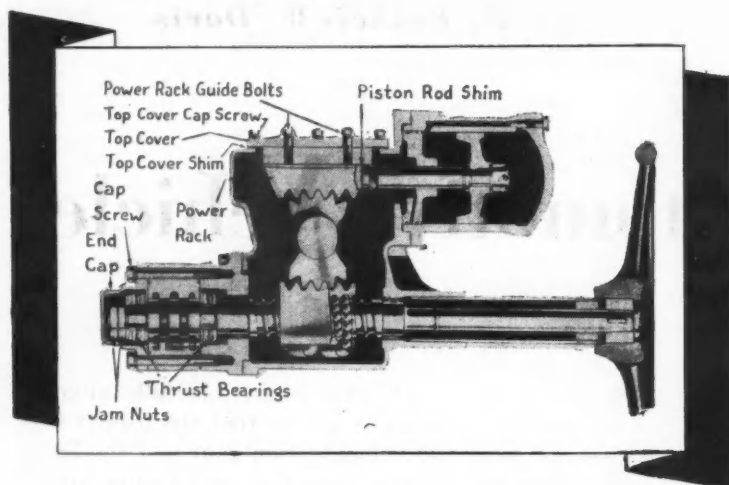


Fig. 5—Saginaw-Bendix—integral hydraulic steering gear

be modified to suit the conditions or requirements. When the steering force required exceeds the output of the power cylinder, the driver supplies the extra amount, and the curve shows the same slope as for manual operation.

In the power gears under consideration, the steering gear worm, cam or screw in no case carries anything but the hand loads. This is the delicate part in a steering gear and is the part that must be protected from excessive shock loads. In fact, by reducing the forces that the driver must apply to the steering wheel, power gears also reduce the loads carried by these parts. This holds both for booster and integral types, for in the latter, the output of the power cylinder is fed in by a cross shaft beyond the reduction gear. The booster type has the additional advantage

that no steering or shock loads are carried by the steering gear housing but are transmitted directly to the chassis.

Engineering Requirements

The directional stability, self-righting properties, feel and absence of noticeable backlash of the modern manual steering gear are qualities which should not be lost when power is added. Backlash is a very definite problem in power gears. Some lag is inherent in a servo since such a mechanism characteristically operates in response to the error or lag between the input signal and the reaction to that signal. The amount of lag required to operate the servo is a measure of its sensitivity. In a steering gear this lag becomes evident as backlash and is something to be avoided as far as possible. Backlash introduces errors in the control of the vehicle, invites shimmy reactions and is generally objectionable to the driver. The driver feels it as wander and oversteering, for he is unable to maintain the vehicle in the desired direction without continual movement of the steering wheel. We can state as a general principle that if the lag is so small that it does not affect the accurate control of the vehicle and is not evident to the operator, then it is within acceptable limits.

In the case of hydraulic gears the valve port opening in the center or neutral position in relation to the movement of steering wheel is a measure of sensitivity. This can be stated as number of degrees of steering wheel to cause the valve ports to close; in other words, the amount of rim movement required to close the valve. It is evident, with piston or spool type valves, that the clearance between the valve parts

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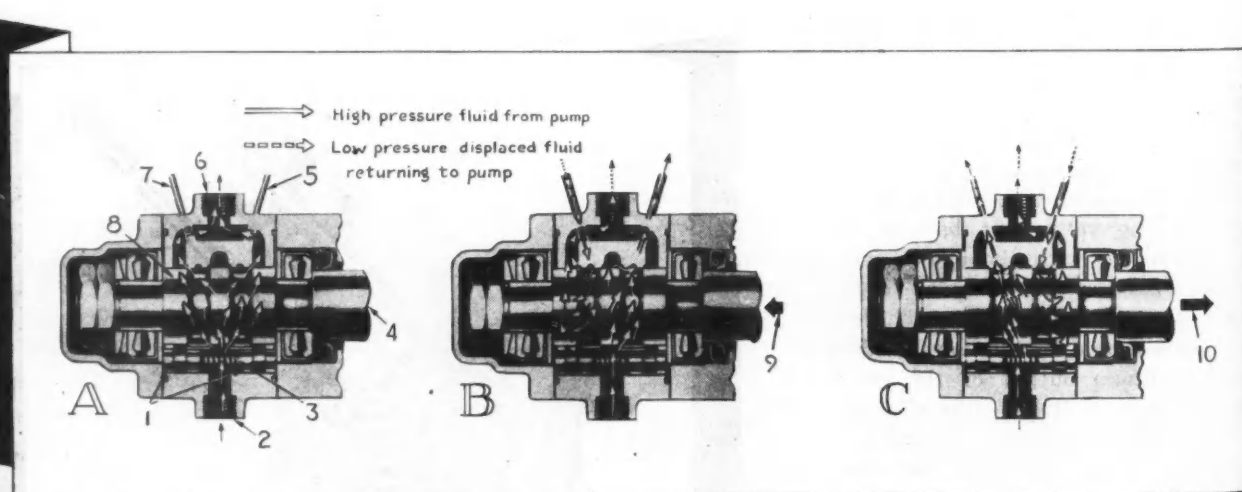


Fig. 6—Control valve used with Ross-Bendix and Saginaw-Bendix hydraulic gears

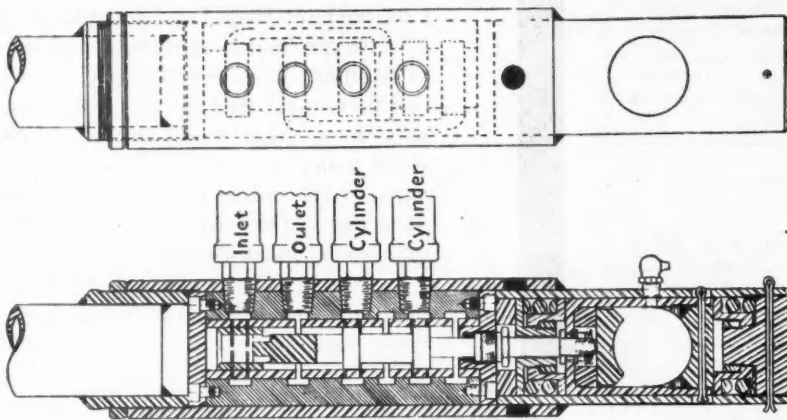
A—Valve position and fluid flow with wheels straight ahead
B—Valve position and fluid flow for right turn
C—Valve position and fluid flow for left turn

2—Inlet connection from hydraulic pump
3—Pre-loaded spring
4—Shaft and spool centered

5—Hydraulic line to top of power cylinder
6—Outlet connection for return to hydraulic pump
7—Hydraulic line to bottom of power cylinder

8—Valve spool
9—Shaft and spool moved downward
10—Shaft and spool moved upward

Fig. 7—Garrison hydraulic steering booster of valve-in-drag link type



travel to close the valve, we have from $1/10$ to $3/10$ of a degree. The angular movement of the Pitman arm is usually greater than the front wheel swing; consequently, the front wheels will move still less than the figures given for Pitman arm travel to close the valve. Within these design limits it is possible to construct a hydraulic

will affect the flow through the valve when the ports begin to overlap; therefore, the stop limits are arranged to permit a certain amount of overlap, usually from $1/32$ in. to $1/16$ in. When the pump is stopped, the steering wheel will show the full valve movement between the limit stops. When the pump is running, however, this movement is much less due to the oil flow and the follow up action. The only other time the valve hits the stops is when added steering torque is required over and above that supplied by the oil. In this case, the driver can add whatever additional steering effort is required up to his physical limit; also, if the oil flow is not adequate for the required speed of steering, the driver may overtake the oil and bring the valve to the limit stop. Experience indicates that a wheel rim movement of from $1/2$ in. to 1 in. to close the valve ports, depending on size of vehicle, is permissible, although it is advisable to keep below these figures where possible. The method of valve operation and the presence or lack of centering springs and hydraulic reaction has an important bearing on this question of sensitivity.

With steering ratios in the order of 30 to 1, we have a ratio of almost 100 to 1 between rim movement and valve movement, depending on helix angle and lead. Therefore, a valve port opening of .01 in. will require a wheel rim movement of 1 in. to close the valve. In the passenger car range we have about one-half this amount of valve opening. If we interpret this valve opening in terms of degrees of Pitman arm

gear which will give good directional control and no oversteering.

Centering springs as used in Bendix hydraulic gears have a decided influence on directional stability and feel; the preloaded springs are located between the reaction plungers which in turn bear against the valve body, thus maintaining the valve in the neutral or center position. They are so arranged that, as the valve is moved from center position by a movement of the steering wheel, it is necessary to exert sufficient force to overcome the preload. In this manner a resistance is introduced which requires a definite number of pounds pull on the steering wheel to move the valve. Until the valve is moved, there is no change in the oil flow, and consequently the steering gear has all the characteristics of a manual gear. It is, therefore, possible to exert a definite steering torque on

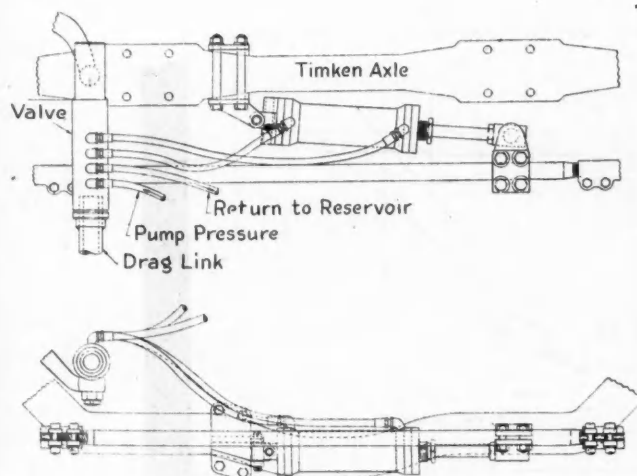
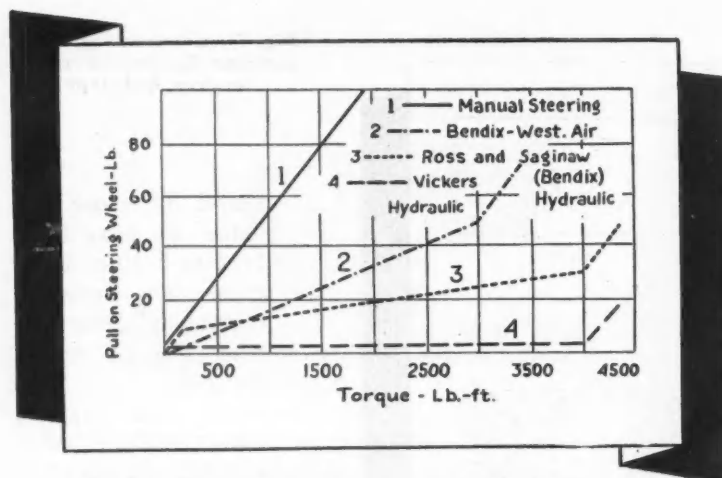


Fig. 8—Installation of Garrison steering booster



the front wheels without moving the valve. This torque is sufficient to maintain the vehicle in its normal path, and the backlash in the steering system is that normally present in a manual gear, for all intents and purposes, zero.

It has been pointed out that, by use of preloaded centering springs, the valve is maintained in its center position unless deflected by the manually applied force on the steering wheel or by road reactions on the front wheels. Conversely, the valve, when deflected from the neutral position, is strongly urged back to center. This action has a profound effect on the system when considered as a servo-mechanism, for the function of the follow-up from the power unit, which is also to bring the valve back to neutral, is thus anticipated. If the centering spring force is of sufficient magnitude to overcome the inertia of the manually controlled elements and to move the

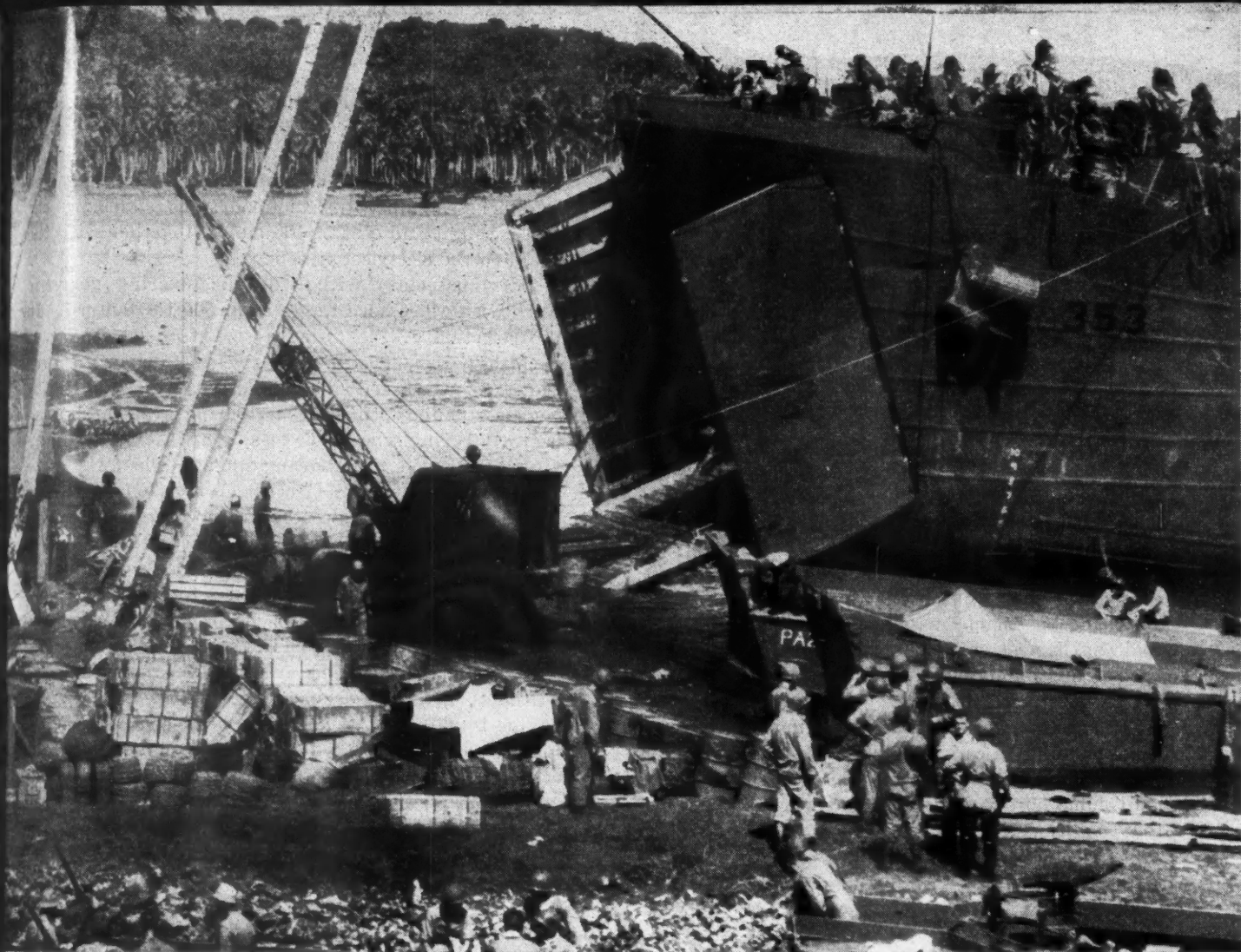
Model	Type	Weight (Lb.)	Rated Torque Output (Lb-ft)	Maximum Pressure (psi)
B-W (7 in. stroke)	Booster	*75	1,580	100
B-W (11 in. stroke)	Booster	*65	2,480	100
Vickers S3-277	Booster	*60	1,940	1,000
Vickers S-315	Booster	*99	4,400	1,000
Garrison	Booster	80	2,070	500
Saginaw-Bendix T-28	Integral	95	1,480	750
Saginaw-Bendix 580	Integral	205	2,880	750
Ross-Bendix 720	Integral	219	4,000	1,000
Ross-Bendix 780	Integral	282	4,296	875

Not include weight of manual steering gear plus mounting brackets and extra levers where
rv.

the pump body, it is desirable to by-pass the oil back to the reservoir for proper cooling. In the case of engine-driven pumps, the delivery must be ample at idling speeds to give maximum working pressures and adequate steering speeds.

With the accumulator system involving a "closed" valve in the center position, the speed of steering is not totally dependent on pump delivery rate. This system involves automatic unloading valves, a hydraulic accumulator, and adds other complexities into the circuit. Up to the present time the production designs all employ the open valve type with the ordinary fixed displacement pump and overload relief valve. A valuable delivery pump can be used, thus supplying the desired volume at low speeds and avoiding the increased delivery at high speeds. However, here again it is a matter of economics and the simpler type pump is preferred by the average user.

The boosters operating on compressed air are hooked up to the tank which normally supplies the brakes and other controls. The speed of steering is ample for all operating conditions, provided there are no restrictions in the lines and valving; also provided the tank and compressor are adequate to carry the increased



Official U. S. Navy Photograph courtesy Bay City Shovels, Inc.

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ler-type crane. In the foreground are personnel landing craft. Thousands upon thousands of tons of Inland plates, sheets, and structural shapes have gone into building cranes and craft of these types.

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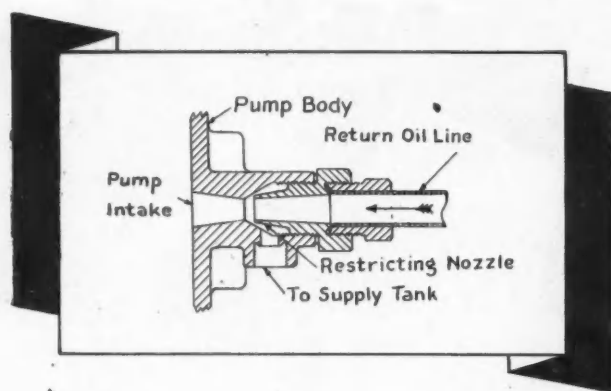


Fig. 11—Supercharged intake to oil pump

load due to steering requirements. The maximum air pressure now used is in the neighborhood of 100 psi, and thus the power cylinder must be large enough to give an adequate output at this pressure. Boosters operating on vacuum supplied from the engine manifold can depend only on a maximum operating pressure of approximately 8 psi. This limits the capacity of the booster to the lowest range in order not to go to excessive piston size. Furthermore, even if the large piston area can be secured by some multiple piston arrangement, the engine can only supply a nominal volume flow without upsetting the induction manifold conditions.

In the case of an electric motor-driven pump, considerable flexibility is permitted, as the pump can be located in any convenient space in close proximity to the steering gear, thus shortening up the piping. The arguments against the motor-driven pump are the extra weight and cost of the motor, together with the drain on the electrical system.

It is customary with hydraulic steering gears to work with a pressure range from 500 to 1000 psi. In the selection of the cylinder size it is customary to furnish power enough to enable the driver to turn the front wheels on dry concrete pavement with the vehicle standing still by contributing a moderate pull on the steering wheel. Excessive hydraulic power invites strains on the steering linkage when the tires are against the curbing or other obstructions and when wheels are against axle stops, as in this position the driver can additionally strain at the steering wheel, thus adding to the steering force.

Once the cylinder size has been determined, the next step is to select the proper sized pump to give the speed of steering desired. In the case of the engine-driven pump, calculations are based on the volume required to give an adequate steering speed when the engine is idling, or usually figured at engine speed in high gear at 10 mph. The pump capacity must take account of the slip in the pump figured at the maximum working pressure and a temperature of ap-

(Turn to page 102, please)

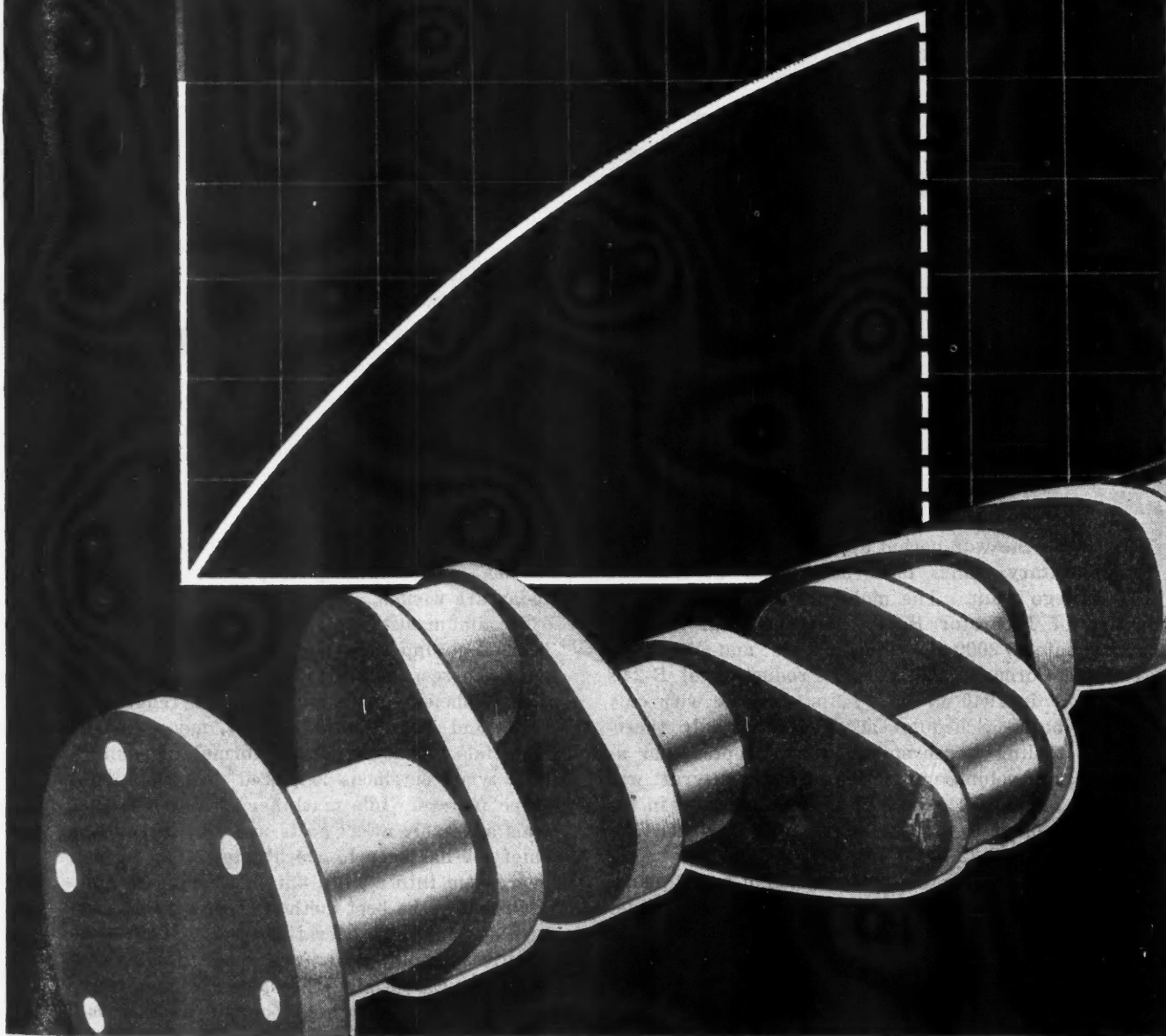
First Civilian Airport Fire Truck



THIS Detroit City Airport fire truck, built by the Cardox Corp. and placed in service last month, is said to be the first equipment of its kind to be used at any civilian airfield in the world. It has a capacity of two tons of liquid carbon dioxide and 200 gal of foam solution, which acts as a blanketing cover after extinguishment to prevent possible re-ignition of the exposed gasoline surfaces. The carbon dioxide is stored in a single mechanically refrigerated pressure vessel at 0 F and 300 psi. Across the front of the truck, ahead of the bumper, is a linear nozzle with a discharge capacity of 1250 lb of CO₂ per min. Mounted

on this nozzle are four fixed foam guns, each of which has a discharge rate of 25 gal per minute. The elevated CO₂ nozzle mounted in front of the truck radiator and maneuverable from the cab has a discharge capacity of 1250 lb per min. and affixed to it is 35-gal per min. foam gun. In addition there are two CO₂ hose lines, each with a 750 lb per min. capacity and mounted on reels at the rear of the cab, and two CO₂ bayonet type nozzles for piercing and flooding plane compartments. The photo on the left shows the beginning of the attack on a large fire involving 300 gal of contaminated gasoline and 100 gal of oil.

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*An assembly line for
Liberator wing cen-
ter sections.*

Convair

DURING the war period approximately 9000 heavy military planes have been made at the San Diego plant. The main project has been production of Liberator B-24's, but the total includes approximately 2000 Catalina PBY's and over 200 4-engined Coronado PB2Y-3's. Production of B-24's started out in 1940 on a very limited scale with only 7 being built. Schedules accelerated rapidly thereafter as tooling improvements were adopted and as experience in volume production of heavy aircraft was acquired. Now B-24 production is tapering off in the San Diego plant to make room for the production of the Dominator B-32.

Plant facilities devoted to production of heavy planes comprise 78 buildings in San Diego, and 15 feeder shops in other communities. Total floor area is 4,614,491 sq ft. The smallest building has an area of 402 sq ft and the largest has 479,375 sq ft.

Efficiently laid out in the buildings are several millions of dollars worth of tools and other manufacturing facilities. The buildings have been planned on a flexible scale so that assembly lines could be adapted with a minimum of change to production of other types of planes. Because of long range planning it has been possible to shift from one type to another without an excessive loss in productivity. For example, as the last San Diego-built Catalina moved down the line before production was transferred to New Orleans, a transport of very different design—a new version of the Liberator Express—followed directly behind it. When the last Coronado PB2Y-3 moved out of the assembly building more than a year ago, it was tagged only a few yards by the first of a new series of land-based Navy bombers.

The total number of employees has ranged during

the last year or two from 44,000 to present figure of 30,000. Approximately 48 per cent of our employees today are women.

Maximum utilization of tooling and floor space has been kept uppermost in the minds of those charged with the responsibility of meeting production schedules. Efficient quantity production requires the complete and coordinated use of men, machines and materials. That production formula is sound, particularly when emphasis is placed upon coordinating the three factors. Idle machinery, manpower, and materials adversely affect costs and slow production. The chief job has been to coordinate the three factors and gear them into a high output organization.

Probably the best method of presenting a clear picture of San Diego operations is to outline some of the practices employed in producing the Liberator B-24 bomber. Essentially, the same methods used in constructing this 4-engined bomber have been used in making other large types such as the Catalina PBY and Coronado PB2Y-3. Undoubtedly, with some modifications, the same principles will be used for production of new and larger types now in the design and experimental stages.

Several years ago when we started building airplanes, it was customary to make them after the order of the pyramid builders in Egypt. The Great Pyramid consists of 2,300,000 stones, each laboriously toted to its position. If a stone failed to fit in position the first time, a stonecutter would trim off the edges until it rested snugly into place. That system was in use in the aircraft industry until comparatively recent years.

A fixed location was selected in a plant and an airplane remained there during its evolution as a completed

Here is one of the simplified mating jigs used by Consolidated Vultee in building Liberators.



By James L. Kelley

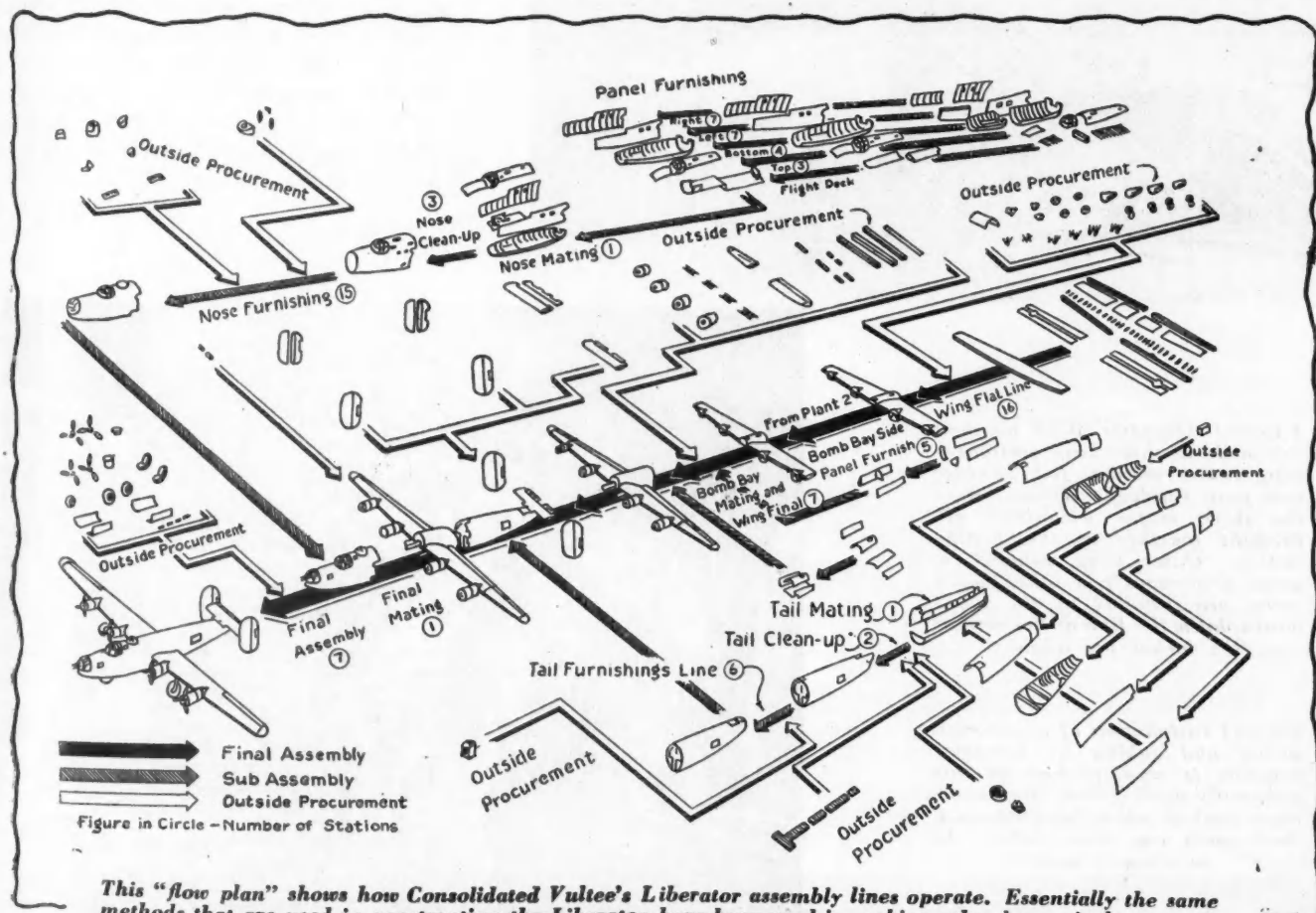
Division Manager, San Diego Division
Consolidated Vultee Aircraft Corp.

Production in San Diego

plane, parts being brought up from all directions.

Early in the B-24 program, it was decided to follow the principle of universal movement wherein not only the parts themselves would move steadily towards the plane, but the plane itself during its construction would move also. Engineers, therefore, designed the

first mechanized line for heavy bombers. This 3000 ft line was set in operation towards the latter part of 1941. For many months its movement was intermittent. At periodic intervals the line would move forward, pulling the 54 bombers in the assembly process one station at a time. Early in 1944 the mech-



This "flow plan" shows how Consolidated Vultee's Liberator assembly lines operate. Essentially the same methods that are used in constructing the Liberator have been used in making other large airplanes, such as the Catalina and Coronado.

anized line was put in gear and left there, a goal production people had sought to reach for some time. Today, the line moves constantly at the rate of $8\frac{1}{2}$ in. per min.

A large airplane like the Liberator B-24 consists of approximately 50,000 individual parts, most of which are fabricated in detail manufacturing departments within the plant. A large bomber has been appropriately compared to a three dimensional jig-saw puzzle, whose parts must fit together with precise exactness and at predetermined times throughout its course of construction.

The first step in the manufacturing job is to examine thousands of blueprints prepared by the Development Engineering department. These cover a multitude of parts. The Product Engineering department, comprising some 1400 employees, studies the engineering prints with a view to altering them to fit the shops and assembly lines. Design engineers have their hands full incorporating new aerodynamic features into a model, with little time to ascertain if parts and cleavage lines match the ever-changing methods of manufacture and assembly. At this "modification center" blueprints undergo alterations as parts are rede-

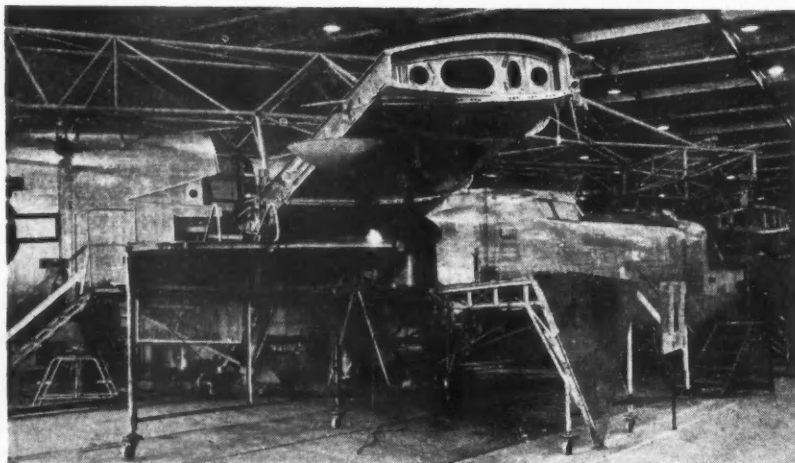
signed from a production standpoint. One drawing received from development engineering may be broken up into several drawings in product engineering. It may, for instance, be impractical from a tooling standpoint to make a certain type belt frame shown on the original drawing. Without disturbing any aerodynamic features of the plane, product engineers will redesign this particular part so that it can be produced quickly in quantities and yet serve its purpose as well or better than its original design.

The modified blueprints become the basis for operating the manufacturing end of the plant. The Production Control department enters the picture at this point since this department is charged with the responsibility of coordinating three elements: (1) determination of the part or assembly to be made, (2) quantity to be produced, and (3) time to be produced.

Foremen consult the schedule for their departments and direct work accordingly. There must be neither over-production nor under-production. Parts must arrive at the right station at the right time and in the right quantity. Synchronization of a vast plant to operate on schedule is an extensive, difficult task due to the fact that combat airplanes are eternally under-

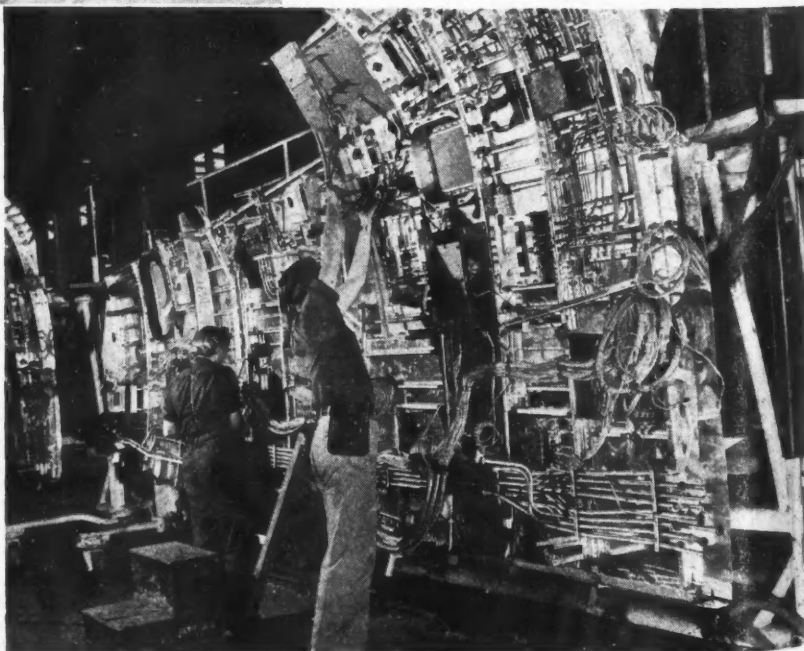
going changes. These changes must be worked into the schedules one by one without disturbing the smooth flow of parts to sub-assemblies to final assembly lines.

The schedules are based on careful studies of departments, and on the master schedule for delivery of completed airplanes in accordance with the sales contract. Studies are made by the Industrial Engineering Department of the time required to manufacture various parts and the time required to assemble them. Time standards are set up from these studies and become the



(Above) Liberator B-24 bombers are made in three large sections—wing center section, tail fuselage and nose fuselage sections. Here the three major assemblies are brought together at the mating station. Outer wing panels, engines, armament and other accessories are installed as the plane moves down the line at the rate of $8\frac{1}{2}$ inches per minute.

(Right) Installation of accessories, wiring and tubing in Liberator bombers is accomplished on this constantly moving line. Man hours were slashed when installation of these parts was made before the panels were mated.



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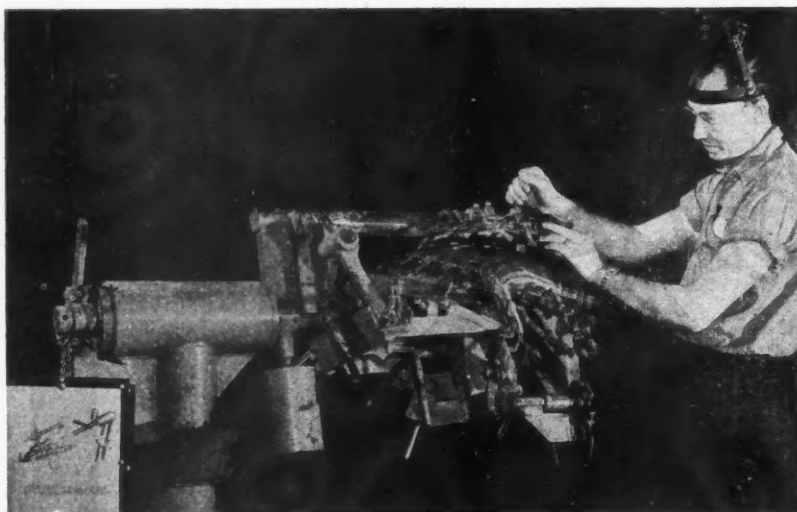
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The welding jig shown here greatly facilitates the process of making aluminum alloy engine air ducts.

foundation for the schedules. With them, the matter of preparing schedules passes from the realm of crystal gazing and becomes a science. The plant has its activities clearly mapped out month in advance.

To cite an example of the scheduling system which is so important to production, the progress of a nose fuselage section may be used. This forward section of the Liberator B-24 fuselage contains the flight deck and most of the nerve system of the bomber. The unit is started in a buck from parts manufactured in fabricating departments. The actual schedule for the nose section on a B-24 was prepared weeks in advance and called for the following work:

FUSELAGE NOSE SCHEDULE

Work to be completed	Time
Buck ready to receive parts	July 4, 1944—6:16 P.M.
Structural members in place	July 4, 1944—8:18 P.M.
Various operations to complete work in buck	July 6, 1944—9:46 A.M.
Drilling and riveting on panels	July 8, 1944—11:04 A.M.
Installation of furnishings, electrical wiring, hydraulic tubing and accessories	July 9, 1944—5:48 P.M.
Mating of panels and connection of wiring, hydraulic lines, and installation of equipment	July 13, 1944—11:56 A.M.

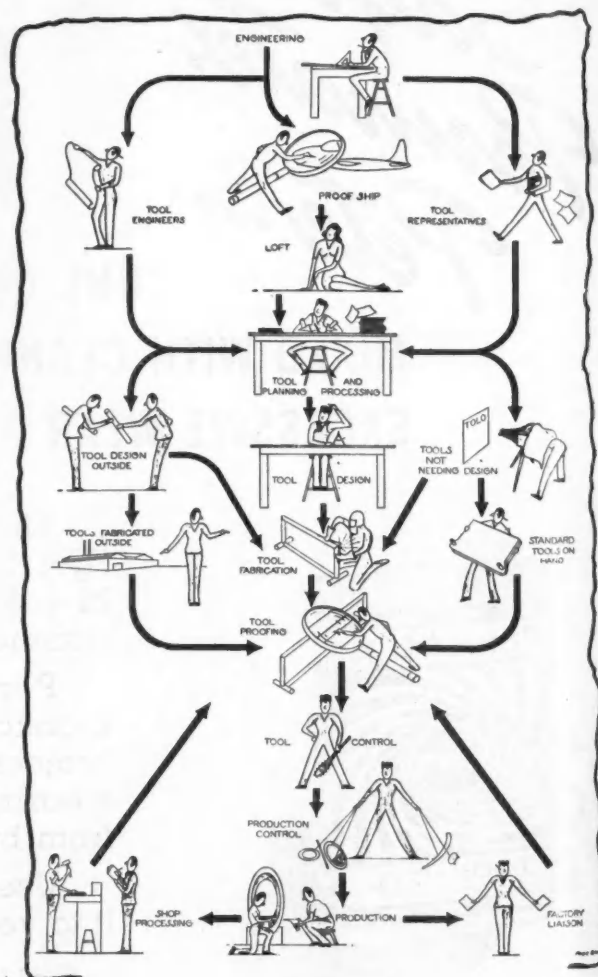
Reference to the records for this component indicated that every completion time was met. Each department through which it traveled finished work assigned to it on schedule. This particular unit was due on another schedule for mating with the wing center section and the tail fuselage section at 1:54 p.m. on July 15. Records show that the three components were there on time. And in conformity with the schedule prepared weeks in advance for completed airplanes, the plane left the final assembly line ready for the flight line on July 20 at 11:24 p.m.

Rigid adherence to the schedules is expected of all departments. Obviously, if one department failed to complete specified work on time, the entire production machine would be thrown out of gear.

Basically, the Liberator B-24 is constructed in three major components—the wing center section, the nose fuselage and tail fuselage. These three sections are made in separate buildings, then are joined together

on the final assembly line about a mile away. After mating, smaller components such as outer wing panels, engines, gun turrets, and smaller accessories are installed as the bomber moves down the final assembly line.

The nose fuselage section of the B-24 illustrates especially well the flow principle in use at the San Diego plant. The evolutionary process it has gone through brings out the progress made in volume production of aircraft. Furthermore, it is a section on which man hours have been radically slashed. Improvements in methods of making it as well as similar developments in building the wing center section and tail fuselage section are important reasons why the cost of a Liberator (Turn to page 70, please)



In the drawing above, Consolidated Vultee's system of getting into production on a new airplane is illustrated. Note the close coordination between engineering, tooling and production units.

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Ship it



Dip it—ship it—strip it. That's the simple story of the remarkable packaging material now being used to protect metal parts during shipment and storage. It is Stripcoat—a Dow developed plastic with impressive properties.*

Metal parts immersed in a hot dip of Stripcoat are covered with a tough, efficient "skin" that protects against moisture, corrosion, and scuffing. At destination, or even following long periods of storage, Stripcoat is easily slit and stripped off. For these reasons, Stripcoat is widely used today for packaging war parts—tomorrow it will be used to ship and store safely mechanical parts of all sizes and descriptions. Why not learn *now* how Stripcoat will fit into *your* postwar packaging plans?

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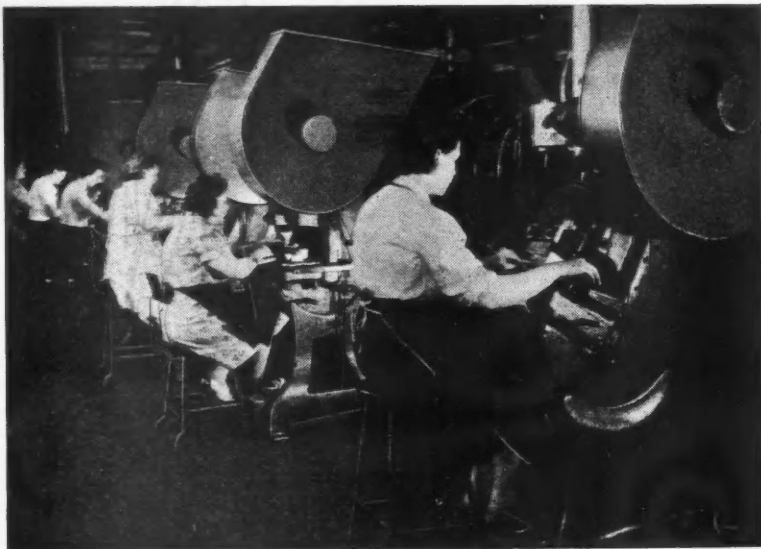
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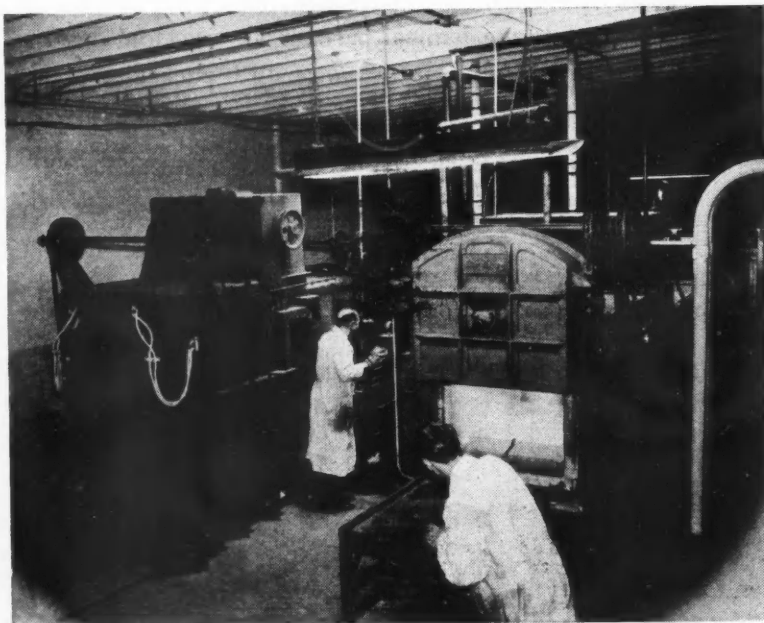
How Metal Bellows are Made

by the
Cook

By Joseph Geschelin



Closeup of one of the rows of inclinable punch presses in the press shop. This department produces the diaphragms and other stampings for bellows and housings.



Here is the battery of two Lindberg controlled atmosphere production brazing furnaces. They are said to have the largest heating chambers in use in this type of equipment.

"SPRING-LIFE" custom fabricated metal bellows possessing the true elastic properties of precision springs constitute one of the principal production activities of the Cook Electric Co., Chicago, Ill. Founded in 1877 for the manufacture of telephone equipment, the company has been established on a sound foundation over the long span of years. In 1924 Cook Electric embarked on the development and manufacture of its line of metal bellows which, during the war, has expanded beyond the limits of present facilities.

At the present writing the company produces the line of Spring-Life bellows in a variety of types and sizes and applications, bellows seals, bellows regulators, pressure detector switches for aircraft and for other applications, and a line of "Magnilastic" bellows of out-size proportions for special requirements.

By the very nature of the product and its service to the automotive industry, the company is essentially an engineering and development organization. Its sphere of usefulness lies in the solution of special or troublesome problems associated with the development of accessories, oftentimes of extraordinary scientific character. This specialization has demonstrated a host of applications for bellows capable of providing unique properties.

It is only natural to find that manufacturing facilities are extremely flexible in character, providing, with few exceptions, a glorified job-shop operation capable of handling the vast variety of parts and assemblies in any quantity from only one piece to hundreds of thousands of pieces. Here and there are self-contained mass-production lines for items made in large volume, for machine coil windings, etc.

Such flexibility of action is intimately related to the adoption of modern manufacturing equipment of every kind, to high standards of precision, and to a maintenance of rigid standards of quality. Further aids to these objectives are good housekeeping; excellent "seeing" by the introduction of high output fluorescent lighting throughout the plant;

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the Cook Electric Co.

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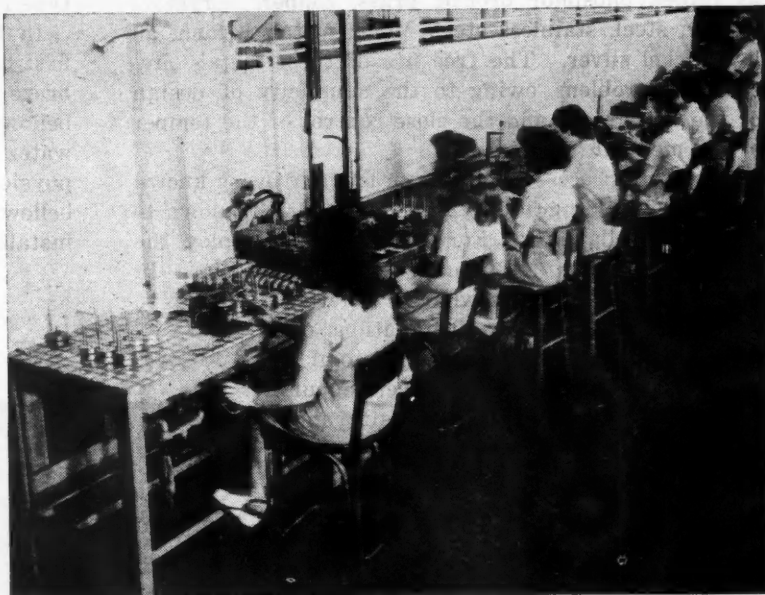
and the adoption of three-dimensional painting pioneered by duPont, in which attention-compelling color combinations are applied to machine tools in the interest of safety and high quality.

The main plant in Chicago contains specialized departments such as the punch press shop, screw machine department, drill press department, fitted with the versatile Delta drills, automatic milling machines, welding equipment, etc., providing self-contained facilities for the fabrication of the elements of various units. Assembly of Spring-Life bellows is handled in a smaller plant concerned entirely with assembly and testing operations. The main plant also provides facilities for research and development in its laboratories; and a metallurgical laboratory for the study of metals and for the testing of incoming materials.

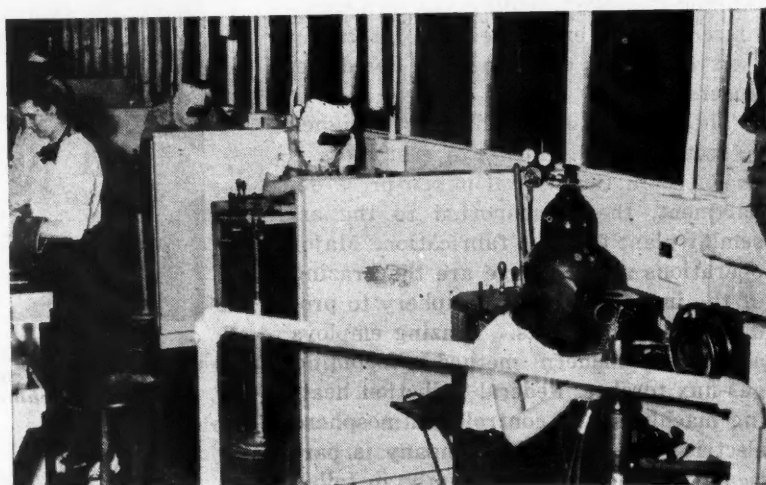
One of the major activities is the production tool room—a large department provided with the latest types of tool room machinery—whose function is the production of tools, dies, and fixtures required for the manufacture of the line of products.

Let us examine briefly the Spring-Life principle and its influence upon the activity of the manufacturing plant. Here is a patented method of construction in which a series of individual diaphragms are joined alternately at their inner and outer peripheries. Each diaphragm is characterized by a flat section with radial or circumferential corrugations and with cupped inside and outside edges. At assembly, the diaphragms are lock-seamed and solder is flowed into the groove to eliminate air bubbles and to assure tightness and strength.

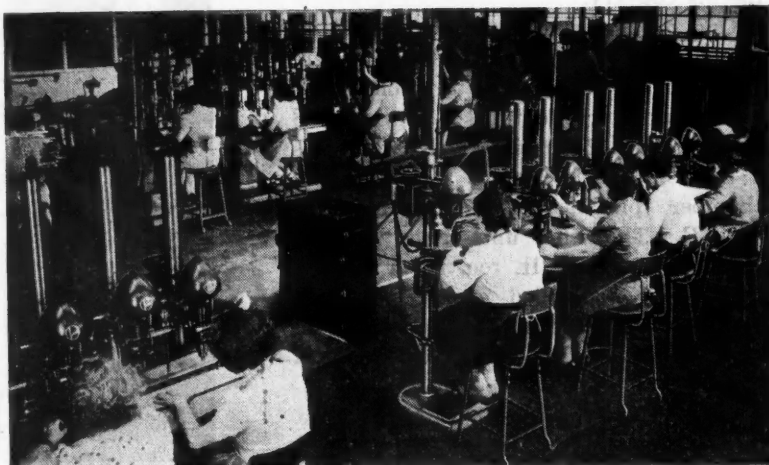
In product application of these bellows, available are an almost unlimited series outside diameters and lengths, wide range of sensitivity, precise calibration, uniformity of movement, and long life. Bellows can be produced in any size, in a large variety of diaphragm sizes and design pattern, and in a wide choice of materials. In the field of materials Cook employs suitably tempered metals such



One of the inspection benches showing the calibration of bellows.



Large bellows of special design are fabricated by atomic hydrogen welding in special booths. This atomic hydrogen welding department is said to be the largest installation of its kind.



A corner of the machine shop. In the foreground are batteries of Delta drill setups; in the background is a corner of the punch press department.

as tinned phosphor bronze, brass, copper, beryllium copper, steel, stainless steel, Monel metal, Inconel alloy, nickel silver. The free use of these metals presents no problem, owing to the simplicity of design of the diaphragm and the close control of the temper of the metal in fabrication.

Assembly processes embody practically every known method of welding and brazing or soldering known to the present day art. For welding they employ the electrical arc and resistance-welding machines. In addition, Cook operates what is believed to be one of the largest installations of the well-known General Electric atomic-hydrogen equipment for the welding of special bellows, free from porosity and capable of maintaining a vacuum as low as 0.01 micron cu ft per hour. Arc welding is done in open booths about five ft square with wall panels about four ft high, eliminating the enclosed canvas booths. Atomic-hydrogen welders are enclosed in booths. All welding booths are provided with fume exhausters in the interest of worker comfort. Atomic-hydrogen welding has been mechanized by the extensive use of rotating fixture, driven by variable speed reducers.

The variety of diaphragms designed to suit the requirements of customers is produced in the central punch press department, then transported to the assembly plant for final fabrication. Major operations at this stage are the brazing of the inner and outer periphery to produce leak-proof units. Brazing employs all known modern methods, including gas-flux torches, Federal induction heating machines, and controlled atmosphere electric furnaces. The company is particularly proud of its recently installed unit of two horizontal Lindberg furnaces for production brazing. These were built to Cook specifications to handle the largest sizes of bellows built in this country.

One of the Lindberg furnaces is an electric furnace of controlled atmosphere type with an integral water-cooled cooling chamber. It features a door size 18 in. in height, 24 in. in width, and takes a tray 36 in. in length. The heating chamber provides a temperature of 2500 F. The other unit takes work of still larger sizes. It, too, is an electric furnace of controlled atmosphere type but is designed with an external oil quenching tank which is served by a hydraulic elevator with the work protected from the atmosphere throughout the operation. This furnace has a chamber 18 in. by 24 in. by 36 in. in size. In addition, there are three small furnaces—two Hayes units and a Lindberg cycle-

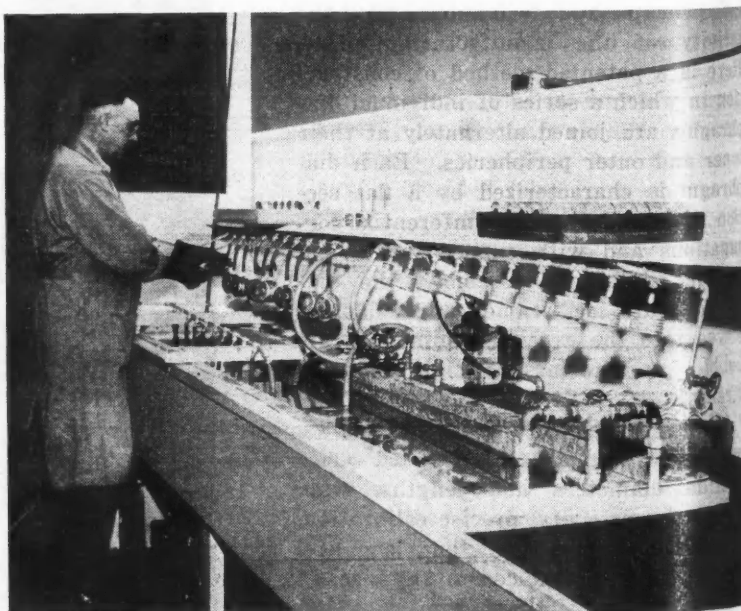
type furnace for the accommodation of the small runs.

In the assembly plant the normal procedure is to first braze the inner, less-accessible periphery, then to braze the outer periphery. Upon completion of the bellows assembly, each unit is suitably inspected by water test, pressure test, hydrogen test, etc., then for physical characteristics. Owing to the fact that Cook bellows are specified as complete assemblies ready for installation, the units are completed by the welding

(Turn to page 64, please)



Some of the bellows assemblies are brazed by induction heating. This view shows one of the special induction heating machines supplied by the Federal Electric Co.



Water tank test is a critical inspection of "Spring-Life" bellows in which each unit is forced to breathe while submerged to prove freedom from porosity.

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STRIES



Buy more war bonds—
and keep them!
Pay \$3—get \$4

To Serve you after V-Day

Until V-day, millions of Sealed Power Piston Rings will continue to go into engines of war to help hasten the coming of that day. Afterward, the largest and best manufacturing facilities in all 33 years of Sealed Power history will be at your service. Meanwhile, Sealed Power engineers invite you to use their experience and the full resources of Sealed Power laboratories to help make your good engines even better.

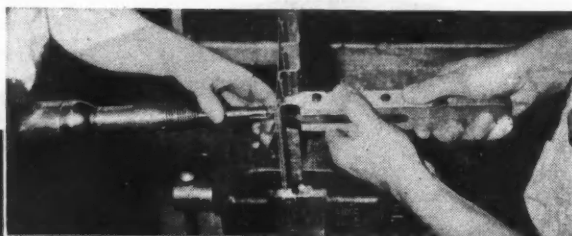
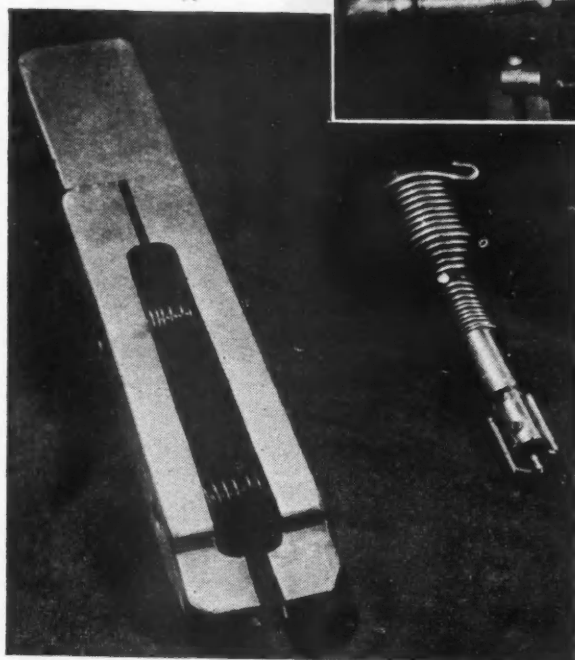


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PISTONS—CYLINDER SLEEVES

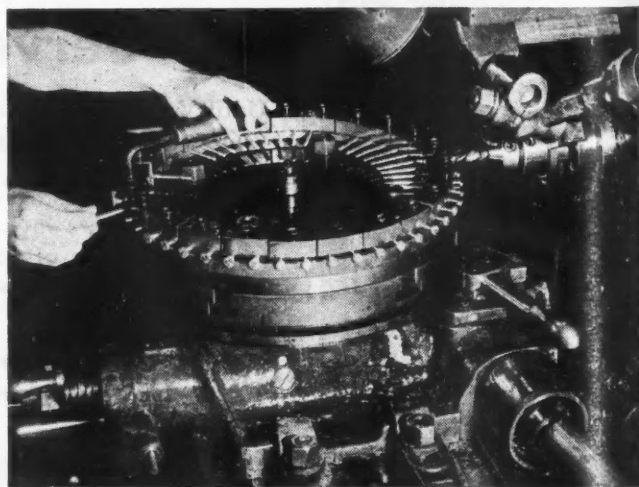
Short Cuts



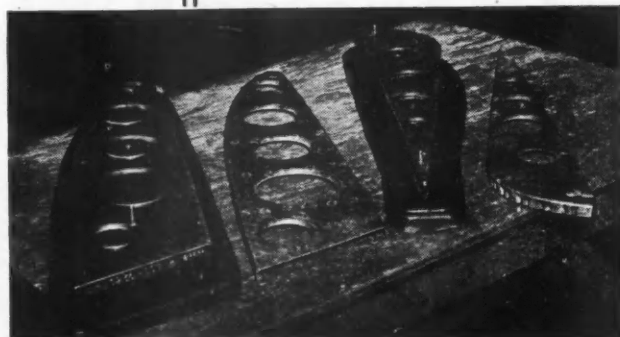
The Rocheville rivet remover, which enables semi-skilled workers to extract rivets without enlarging holes or otherwise mutilating the part, is giving satisfactory service at the San Diego plant of Consolidated Vultee Aircraft Corp. It consists of a shaft (right), which can be fitted into a conventional pneumatic rivet gun, and a new type "buckling bar" (left), which is handled manually.

Rivets are removed by percussion. The slender "driver" inside of the shaft receives pneumatic impulses from the rivet gun and conveys them to the center of the manufactured head of the rivet. The shape of the shaft is such that its driving end fits snugly over the rivet head, making it virtually impossible for the driver to slip into the wrong position. While blows from the driver are being applied to the manufactured head of the rivet, the new-type "buckling bar" is clamped over the driven head. This bar is split and hinged so that its recessed face can be fitted over a driven head of any given size. The buckling bar is used to pull at the driven head while blows from the rivet gun are centered on the manufactured head, and this brings maximum stresses to bear on the shank. The strength of the base material then causes the shank to be sheared through the manufactured head.

A new method that prevents buckling in airplane ribs has been devised at the Linden plant of the Eastern Aircraft Division of General Motors. Corrugations are pressed into SW aluminum flat stock during the forming operation, setting the metal to the limit of its elasticity and thus eliminating most of the curling and warping that results from pre-heat. About 75 per cent of the hand hammering has been eliminated and in addition rib strength is said to be increased about 20 per cent. Corrugations in the face of the forming block are .008 in. deep and .25 in. wide. Thus the depressions on the rib are about .005 in. high. The corrugations are 45 deg., plus or minus 15 deg., to the chord line on the rib. In the photo, left to right, are: new forming block and corrugated rib, conventional forming block and rib.

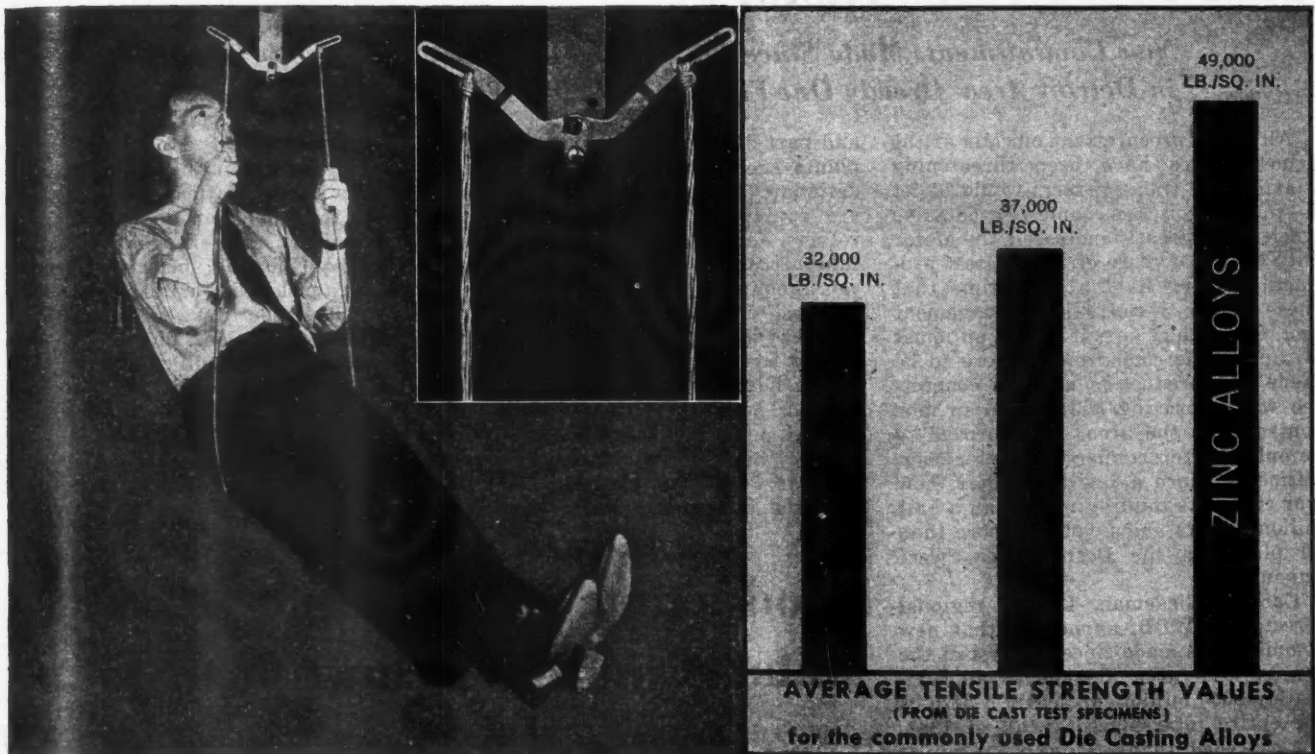


The replacement of a single bolt set-up with a multiple rotary chuck to permit continuous feed has brought about a 450 per cent production increase in the bolt milling operation at the Baltimore plant of The Glenn L. Martin Co. The operator can remove finished bolts and insert more work without interruption of the feed.



TENSILE!

— ZINC ALLOY DIE CASTINGS
CAN TAKE A "MAN-SIZED" LOAD



This simple test of a pair of zinc alloy die cast brackets (see close-up) was made to dramatize tensile strength. There was no need for the gentleman's tense expression—the zinc alloy die cast brackets easily sustained his weight without deformation. You may never have a part with equivalent demands for tensile strength, but this test graphically illustrates the physical characteristics of zinc alloy die castings.

Tensile strength is just one of the physical properties of the zinc die casting alloys which is not equaled by either of the other commonly used die casting metals. Zinc alloy die castings are also superior in impact and compressive strength, ductility and hardness.

These strength characteristics, coupled with speed of production, clean-cut appearance and low cost, have made die castings of zinc alloy the most widely used. *Every die casting company is equipped to make zinc alloy die castings*, and will be glad to discuss these advantages with you—or write to The New Jersey Zinc Company, 160 Front Street, New York 7, New York.



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The Research was done, the Alloys were developed, and most Die Castings are specified with
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1945 to Be Greatest Production Year in Detroit's History

New Commitments Made Since the First of this Year in Detroit Area Already One-Fifth of the 1944 Total

Although procurement officials of the armed forces have been threatening that no new war contracts would be let in the Detroit area unless productive efficiency is greatly increased, the Motor City is on the verge of its greatest production year. At the same time that these officials were telling management and labor that output per man must go up if new commitments were to be made, the production urgency committee was approving \$93 million in new contracts in the area. This proved to be only the forerunner of greater commitments, since a few days later, new war contracts totaling more than a half billion dollars and involving more than 40 plants in the Detroit areas were announced.

Carsten Tiedeman, Detroit regional director of WPB, announced that new commitments made since the first of the year in the area amount to approximately \$604 million, or nearly a fifth of the entire total placed in all of 1944. He conceded that although Detroit is a No. 1 critical labor area, there was no alternative in view of the automotive center's production facilities and manufacturing skill. In addition to the new war contracts for materials, plant construction and facilities totaling more than \$50 million were authorized.

Automotive manufacturers listed among the major contractors receiving new war work are: Chrysler Corp., \$908,000 for marine gas engines and \$3,331,000 for rockets; Murray Corp., \$1½ million for cartridge storage cases; Budd Wheel Co., \$2,525,000 for high explosive rockets; Ford Motor Co., \$298,844,000 for B-24-N single-fin bombers, and \$130 million for 2800-hp airplane engines and parts. Contracts for new manufacturing facilities include Cadillac Motor Div. of General Motors Corp., \$12 million for tank fabrication; Ford Motor Co., \$4,700,000 to increase tank engine production at the Rouge plant; Chrysler Tank Arsenal, \$15 million for additions; Budd Wheel Co., \$2 million to step up wheel production; U. S. Tire and Rubber Co., \$6 million to speed tire output.

An instance of the greatly expanding effort is the Navy's billion-dollar rocket program, of which \$150 million has been channeled into the Detroit District, comprising Michigan, Indiana,

and part of Ohio. More than 1500 war plants are involved, with 17 of them designated as prime contractors who are equipped to turn out rockets in volume and the remainder acting as subcontractors. Another program, not yet announced, will make the Detroit area the chief producer of one of the newer type weapons. This program is said to be of astounding proportions.

This headlong expansion of war production bears out the recently announced policy of the military and WPB to carry on under the assumption that the war has no foreseeable end. Despite the favorable news from Europe

since the beginning of the Russian drive, there is no visible sign of optimism in government circles; on the contrary the pressure is greater than ever. This is a natural corollary, since to put the heat on labor for increased effort while at the same time to speculate on an early end of the war in Europe simply would not add up to anything sensible.

The manpower situation continues baffling in the face of military pressure for labor legislation, opposition from labor and management to any kind of labor draft, and charges and countercharges of loafing, inefficiency, mismanagement, slow-downs, and labor hoarding. That there are such practices in vogue is common knowledge. Union leaders privately will concede that there have been some cases of shop stewards deliberately holding down production, of crap games in washrooms, and other abuses. Certainly management knows it. But the point of contention is just

(Turn to page 94, please)

Production of Silver and Other Metals Continues Downward Trend

Existing Conditions Cause Wide Gap Between WPB Programs and Current Output of Metal Producers

By W. C. Hirsch

The production of more and more metals registers declines. The latest to attract attention is a dip of approximately 17 per cent from the preceding year's domestic production of silver, the use of which in the form of solders and brazing alloys has now become the most important industrial outlet for the metal. A large amount of silver serves in aircraft engine bearings as well as in the making of mortar shells and incendiary bombs. Questions of monetary and fiscal policy enter into a full consideration of the market status of silver, but the fact remains that the metal, which might be considered an added starter in the race for position in the industrial field when war became a certainty and the supply obtained from other sources had to be augmented, suffers in addition to other handicaps, from a contraction in the output of nearly all the important producing countries. While it is generally admitted that when depleted labor markets, critical fuel conditions in many parts of the country, and transportation difficulties are taken into consideration, nothing short of miracles are being performed in many non-ferrous

as well as steel plants, the overall picture continues to be disheartening because of the wide gap between current WPB programs and the limitations upon output imposed by existing conditions.

The Army ammunition program now envisages an increase in carbon steel requirements from approximately 2,000,000 tons in the first quarter to 3,400,000 tons in the final quarter of 1945. In 1944, the Army expended slightly less than \$4,000,000,000 for ammunition. This year it is planned to step this up to more than \$6,000,000,000. Half of this appropriation would go for shell steel billets, one-fifth for sheets and somewhat under one-tenth for tubing and hot rolled bars. It is estimated that the landing mat program will call for approximately 475,000 tons of hot rolled sheets in the first half of the year and about 335,000 tons in the second half.

In a recent WPB release, it is pointed out that aluminum sheet and extrusions present the most critical phase of the aluminum problem. "Indications are that the heavy presses will be taxed to capacity," says the release. It is explained that the difficulties resulted

(Turn to page 88, please)

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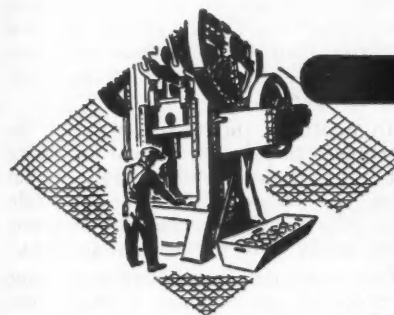


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BETTER HARDENING RESULTS.....

Definite help in overcoming hardening troubles, cracking, size change, distortion, and premature service failures that contribute to excessive tool costs and production holdups.



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First aid procedure for curing tool-caused interruptions to machine output. Tools that stay on the job longer between grinds, mean fewer shutdowns and lower unit costs.

The Carpenter 3-way program makes it easy to get better tooling *fast*—and bring about savings in tool costs and production costs. War plants found this program a life saver in boosting war output. Now, this same program will help to speed reconversion and bring needed cost reductions.

1 SELECTION OF TOOL STEEL ON PERFORMANCE
The Carpenter Matched Set Method simplifies selection. It guides you to the proper tool steel for each job—the steel that will give you the required combination of properties for maximum production performance.

2 RECOMMENDED HEAT TREATMENT PROCEDURE
Clear, simple, easy-to-follow, printed instructions are provided for heat treating each Carpenter Matched Tool Steel, to get the desired results. Proper heat treatment assures safe hardening and savings in tool making costs.

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How to get started on this cost reduction program: Send for the Matched Tool Steel Manual. It explains this time-proven plan in detail—contains heat treating instructions for each steel, and includes an 80-page tool index and steel selector that really simplifies production. Write for a copy today on your company letterhead, stating title or position. (Free to tool steel users in U.S.A.)

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WLB Panel in Washington Recommends Grievance Machinery for Foremen

In a report of significant implications for the automotive industry, a special WLB panel in Washington handed down a report January 31 recommending that 12 large companies establish grievance machinery for foremen and other supervisory employees. The panel pointed out, however, that questions involving bargaining rights and union recognition were beyond its jurisdiction.

The report was the outgrowth of repeated disputes between management

and supervisory personnel, represented chiefly by the Foremen's Association of America, an independent union, and two other foremen's groups within the CIO and AFL. Previously, the NLRB had ruled that foremen are representatives of management and therefore not entitled to collective bargaining rights. However, there have been symptoms of a softening in WLB's stand, as indicated by the appointment of the special panel to delve into the matter further. This panel has been holding

sessions in principal cities throughout the country, including one of two months duration in Detroit, taking evidence. Included among the 12 companies involved in the hearings were Aeronautical Products, Inc., Briggs Mfg. Co., Chrysler Corp., Packard Motor Car Co., Gar Wood Industries, and Hudson Motor Car Co., all of Detroit; Bohn Aluminum and Brass Co., Adrian, Mich.; and Republic Steel Corp., Cleveland.

Although the FAA has hailed the panel report as a signal advance in its fight for recognition, closer scrutiny discloses that the findings were something less than a victory for the foremen. In the first place, the findings of the board are in the nature of recommendations which are subject to comment from both management and unions before WLB takes final action, which may not occur for several months. Also, it was pointed out that the foremen have relatively few well-supported complaints, that they are generally well paid, that charges of being by-passed in dealing with grievances of men under them and of not being backed up in disciplinary action are unsupported by the record, and that disputes involving overtime pay have been resolved in the cases of the Michigan companies.

In addition, the report states, "The foremen's complaints appear to spring not from unjust working conditions, but from the desire of foremen to retain their jobs and to interchange viewpoints more freely with higher management."

One additional recommendation made in favor of the foremen is that night shift supervisors be paid a bonus, provided that their work is the same as that of day foremen and that this is the general prevailing practice in the industry and area.

Members of the special panel were Sumner H. Slichter, Harvard University; William Spohn, attorney and labor arbitrator at Madison, Wis., and Dean Robert D. Calkins, Columbia University.

H. C. Thomas Elected President of APMA

Hayward C. Thomas, president of Clarke Aero-Hydraulics, Inc. of Pasadena, was unanimously elected 1945 president of the Aircraft Parts Manufacturers Association at the initial meeting of the newly elected board of directors of the Association. He succeeds T. T. Arden, president of Grayson Heat Control, Ltd., who served as chief executive of the organization for the two previous years, and who remains on the board of directors. F. W. Wilkins, vice president and general manager of United Aircraft Products, Inc. was elected vice president; the new secretary is J. D. McDonald, president of the McDonald Manufacturing Co. and the treasurer Ralph Middleton, chief engineer of the Aireon Manufacturing Co.



STERLING ALUMINUM PERMANENT MOLD CASTINGS FOR ALL INDUSTRY

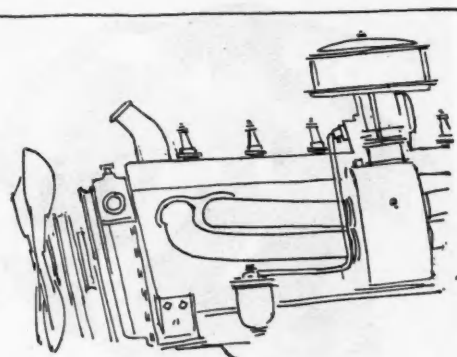
Sterling has for years produced fine pistons by using a unique and proven, patented molding process, fine quality materials, and unsurpassed skill in workmanship.

In addition to our piston factory, we are just completing a very modern foundry that will produce all types of aluminum permanent mold castings.

Our staff of engineers will be glad to assist you with your engineering problems. Their experience may be valuable to you.



STERLING ALUMINUM PRODUCTS Inc., St. Louis 6, Mo.



MR. ENGINEER... 66 years is a lot of leather

In 66 years of processing leather to protect and seal machine parts, Chicago Rawhide has solved again and again the toughest problems posed by the inventive genius of America's top industrial engineers. Three factors are responsible for the success of Sirvis leather products . . . the solid foundation of knowledge about mechanical leather which is Chicago Rawhide's greatest asset . . . the custom-built designs developed by research engineers who have learned that each new problem needs special consideration . . . and the rigid laboratory control in every stage of production, which insures absolutely uniform performance under all service conditions.

If protection is your problem, why not draw upon this unparalleled reservoir of specialized engineering experience? If your postwar designs include parts where irregular, eccentric or universal action makes a rigid seal impractical . . . a Sirvis leather boot may be the answer. If unusual precision, resilience, long

service or resistance to pressure, shock, or vibration is demanded in packings, washers, gaskets, couplings or valve discs . . . Chicago Rawhide research can develop the properties you require, and careful production control can assure the most exact processing. For precision performance in protective coverings and seals, specify Sirvis mechanical leather.

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February 15, 1945

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45

C. E. Wilson Heads Standards Committee

A committee of eight industrial executives with Charles E. Wilson, President of the General Electric Company as Chairman, has been appointed by the Secretary of Commerce to advise the Department of Commerce and the American Standards Association on future plans for standards work. This appointment is the first action to come out of a conference of 50 business leaders held in New York on January 12 at the invitation of the Secretary of Commerce to make recommendations to

him in regard to the relative roles which should be played by Government and industry in standards activities. Serving with Mr. Wilson on the Committee are: Frederick M. Feiker, dean of engineering, George Washington University; Clarence Francis, chairman of the board, General Foods Corporation; Ephraim Freedman, R. H. Macy & Company, Inc.; Frank B. Jewett, president, National Academy of Sciences; William B. Warner, president, McCall Corporation; Arthur D. White, president, Dun & Bradstreet, Inc.; R. E. Zimmerman, vice-president, U. S. Steel Corporation.

The Conference, presided over by

Wayne C. Taylor, Under Secretary of Commerce, recommended that industry should provide a strong leadership in the development of national standards and that this should be done in full cooperation with the Government.

PUBLICATIONS

A new 16-page engineering bulletin, describing Flex Fitting, has been issued by The Imperial Brass Mfg. Co. Complete descriptive information is given on this fitting, together with the results of comparative vibration tests of Flex. Dimensions for each type and size of Flex Fitting and installation instructions are also included.*

The A. F. Holden Co. has issued a new 4-page folder showing the standard types of Electric Electrode Furnaces it manufactures. The bulletin includes line drawings showing construction of four types of electrode furnaces.*

The South Bend Lathe Works has issued the 43rd Edition of their book, How To Run A Lathe. A number of changes in text material and illustrations have been made since the previous edition. It contains the latest information on the operation and care of metal working lathes, and covers such subjects as the operation of the lathe units, grinding cutter bits, making accurate measurements, etc.*

Bakelite Corp. has issued an 8-page technical data booklet, Bakelite Cold-Setting Phenolic Resin Glue XC-17613 which explains formulations, mixing procedure, working life of glue, spreading, etc. Illustrations include graphs showing pot life, assembly times and clamp periods. Another booklet, Urea Resin Glues, by Bakelite, describes and illustrates the uses of these glues for plywood and densified wood.*

A new technical booklet, which lists and describes the results of dimensional stability tests on cellulose plastics at high temperatures and high humidities, has been issued by Hercules Powder Co.'s Cellulose Products Dept. Color sketches, photographs, tables, an explanation of test conditions and a discussion of data contained in the sketches, photographs and tables are included.*

A handy pocket-size booklet containing the list of chemicals made and sold by Hercules Powder Co.'s Cellulose Products Dept., types available, their end uses, and pertinent packing and shipping information is available.*

Allegheny Ludlum Steel Corp. has issued three new publications, as follows: Catalog on Carmet carbide blanks, carbide tipped tools and AL tool shank steel in cold drawn bar form; 20-page Manual containing complete data on Carmet carbide tipped tools; Catalog describing carbon and high speed steel drill rods and cold drawn tool steels.*

A new edition of Aircraft Engine Lubrication, adding information about aviation greases and lubrication of accessories to the complete discussion of engine lubrication, has been issued by Sinclair Refining Co. Types of aviation greases, their composition, manufacture and testing are fully discussed in the added chapters. Lubricating characteristics and the application of the grease lubricants are described.*

A new 4-page bulletin has been published by the Metallizing Co. of America, describing the new Moguloid Process. Descriptions of repair jobs by this method, and of equipment required for a Moguloid shop installation are given.*

The Cleveland Pneumatic Tool Co. has issued a booklet, Pioneers for 50 Years, which commemorates the 50th anniversary of the founding of the company.*

* Obtainable by subscribers within the United States through Editorial Dept., AUTOMOTIVE and AVIATION INDUSTRIES. In making requests for any of these publications, be sure to give date of the issue in which the announcement appeared, your name and address, company connection and title.

RECORD OF ACHIEVEMENT



TANTUNG
Blue Streak
SHELL END MILLS

FIVE SIZES
2 1/4" 2 1/2" 3" 3 1/2" 4"
DIAMETERS

COMPARATIVE CUTTING PERFORMANCE

	HIGH SPEED STEEL	TANTUNG BLUE STREAK
S. F. M.	80	145
R. P. M.	76	136
FEED	3 1/2"	5 1/2"
DEPTH OF CUT	1/4"	1/4"
PIECES PER GRIND	2	16

MATERIAL CUT: Hard Nickel-Chrome-Molybdenum-Steel. Machine: Kearney & Trecker, Model K, 7 1/2 HP. A coolant was used. Conventional cut.

YOU CAN GET THE SAME RESULTS! Tantung is easy to sharpen. Easy to operate. Use same technique as for high-speed steel cutters, only increase RPM and FEED. Write for Bulletin V-R 338.

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Every Industrial Executive, Engineer and Designer should see this picture

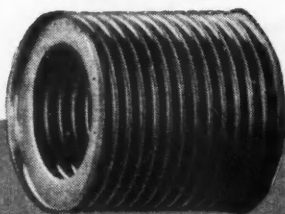
SIMPLE as bellows are, words often fail to show the limitless design possibilities inherent in these versatile metal diaphragms. Too often many engineers have assumed that bellows only had application in a few fields, when actually they have been successfully applied to scores of designs in dozens of different industries.

"The Story of Metal Bellows" is an interesting and informative sound film, vividly showing the basic application characteristic of a Sylphon Bellows. It shows just how a bellows converts pressure and temperature changes into controlled mechanical movement, and demonstrates graphically how this movement is harnessed to perform innumerable tasks.

This picture is one of the most thought-provoking industrial films ever produced. We are sure your organization will find it stimulating. Let us know when it will be convenient to have this 28-minute sound film shown to your group, at no cost to you. 16 MM or 35 MM film available.

1. A specially designed hydraulic machine forms metal bellows from one-piece tubes.
2. Fundamental applications of bellows are shown in animation... may suggest how you can profitably employ Sylphon bellows.
3. This portion of the film explains the operating principle of various types of temperature controls.

FULTON



SYLPHON

TEMPERATURE CONTROLS

BELLOWS... BELLOWS ASSEMBLIES

THE FULTON SYLPHON CO., KNOXVILLE 4, TENNESSEE

Canadian Representatives, Darling Brothers, Montreal



STANDARD ROSÁN
LOCKED-IN STUD



STANDARD ROSÁN
LOCKED-IN INSERT

IMPORTANT to Designers

DESIGNERS who have encountered the problem of adequate fastening in soft metals, plastics and wood have found the answer in Rosán Locked-in Threaded Inserts and Studs.

Rosán Fastening Units are locked in the material; they can be easily removed without special tools and without disturbing the parent material; they require no oversize replacements; and they effect enormous savings in oversize parts inventory and parts salvaged.

With these fastening units it is now possible to use materials which have hitherto been considered impractical on account of the fact that a bolt screwed directly into them would pull out under tension. Vibration would cause an insert or stud to loosen and back out and the torque applied to a frozen nut would invariably back the stud out with it and necessitate an oversize replacement. Rosán Fastening Units have completely done away with these conditions.

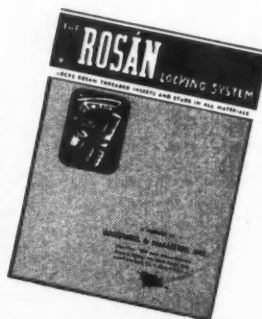
HOW THEY WORK

A locking ring, serrated inside and out, engages its inner teeth with a serrated collar on the Rosán Insert or Stud. The outer teeth of the locking ring broach their way into the parent material at the surface of a counterbore when driven or pressed into place. This makes the insert or stud an integral part of the parent material and completely permanent.

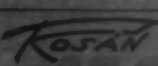
SEND FOR OUR FREE CATALOG

Rosán Locked-in Inserts and Locked-in Studs are the solution to innumerable fastening problems in all types of industry. New applications for these fastening units are being developed by our engineers and by our clients regularly. Manufacturers are invited to submit their problems.

Write for free literature on the Rosán Locking System.



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IAS Elects C. H. Colvin As President for 1945

Charles H. Colvin of New York was elected president of the Institute of the Aeronautical Sciences for 1945. He succeeds Major R. H. Fleet of San Diego, Cal. Elected as vice presidents were: W. A. M. Burden, Assistant Secretary of Commerce; Leroy R. Grumman, president of Grumman Aircraft Engineering Corp., Bethpage, Long Island; I. M. Laddon, executive vice president of Consolidated Vultee Aircraft Corp., San Diego, Cal., and Arthur E. Raymond, vice president in charge of engineering of Douglas Aircraft Co., Santa Monica, Cal. Earl D. Osborn, president of Edo Aircraft Corp., Flushing, Long Island was elected as treasurer.

Major Lester D. Gardner was re-elected chairman of the council; Bennett H. Horschler, executive vice president; George R. Forman, assistant to the president; Robert R. Dexter, secretary and Joseph J. Maitan, controller.

Gold Medal of AIC Awarded to J. W. Thomas

The Gold Medal of the American Institute of Chemists was awarded to John W. Thomas, chairman of The Firestone Tire & Rubber Company and directing head of its operations. The medal was given in recognition of the leadership of Mr. Thomas in rubber research for four decades, and for achievements under his direction in the development and production of synthetic rubber.

Obituary

Carl H. J. Becker, at one time sales manager for Chalmers Motor Co. and later Georgia distributor for the Hudson Motor Car Co., died in Washington, D. C., Jan. 27 after an illness of two years. He was 51 years old. In recent years he had been a breeder of registered Jersey cattle on his farm at Gainesville, Va.

John W. Kelley, general superintendent of inspection for the Chevrolet Gear and Axle plant, died Jan. 25 at the age of 53. He had been ill since last September.

Fred W. Grant, merchandising engineer of Norton Company, Worcester, Mass., died suddenly January 25 at Worcester. Mr. Grant had been with Norton Company for 32 years and was appointed merchandising engineer in August, 1944. For the previous 19 years he had been abrasive engineer in the Milwaukee territory.

Advertising Note

Acheson Colloids Corporation announces the appointment of The John Mather Lupton Company, Graybar Building, New York City, as its advertising and marketing counsel.

Buy More War Bonds and Stamps

SERVICE

in Seven League Boots

BORDER to border—coast to coast—wherever skilled technical service may be needed, Jack & Heintz can be on the job in 24 hours! Not satisfied with mass producing precision aircraft equipment for war, we have built up a corps of trained field experts to help with its installation and maintenance.

Since Pearl Harbor, this group of nearly a hundred specialists has

done yeoman duty in keeping 'em flying for victory. Because idle planes are as profitless in peace as they are useless in war, these men can be a tremendous asset to post-war commercial aviation.

Remember, in future planning, that all Jack & Heintz products—instruments, starters, motors, generators, magnetos—are backed by nationwide service . . . in seven-league boots!

aircraft engine starters, generators, gyro pilots, gyro flight instruments, magnetos, motors.

February 15, 1945

When writing to advertisers please mention AUTOMOTIVE and AVIATION INDUSTRIES

New Production Equipment

A 50-kw electronic heater for surface and localized hardening of gears, rods, and other parts and for annealing, brazing, and soldering operations, has been added to the line of the Industrial Heating Division of the General Electric Company. The new heater incorporates all of the important features of the 5-kw and 15-kw G-E heaters

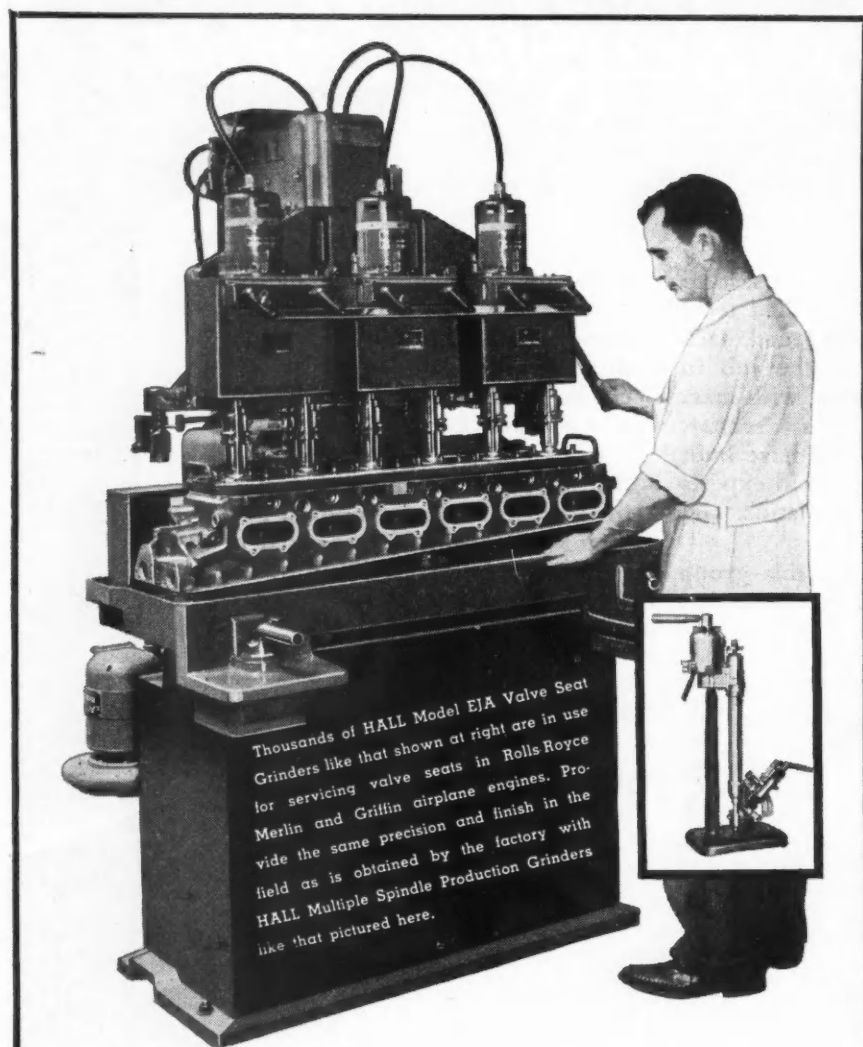
and, in addition, is capable of heat-treating much larger parts or the same size parts in less time. This heater is readily applicable for many different heating jobs merely by changing the induction-coil fixture.

The new unit is available in models rated either 230 or 460 volts, 3 phase, 60 cycles. The parts to be heated are

positioned in the fixture, and the "start" button is pressed. Automatic controls then regulate the heating and quenching cycles. An attached work table provides two heating positions, permitting full utilization of the high-frequency power supply to secure maximum production.

A N ALL-PURPOSE furnace has been developed by Lindberg Engineering Company, Chicago, Ill. It is designed for silver brazing at low temperatures, copper brazing at high temperatures, powder metallurgy, bright annealing, general tool hardening and high speed tool hardening. Unusual flexibility of use results from its wide range of attainable working temperatures—from 1300 F to 2500 F.

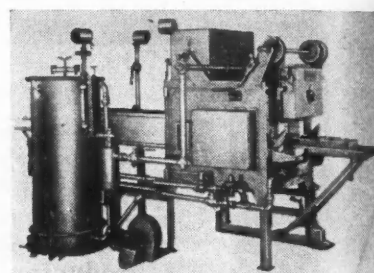
The construction of this new furnace permits the handling of heavy loads at high temperatures, making its use especially efficient for the sintering of pow-



HERE'S one of the HALL Multiple Spindle Eccentric Valve Seat Grinders as used by Packard for high speed production of Rolls-Royce airplane engines. Grinds six seats simultaneously with identical precision and finish.

THE HALL MANUFACTURING COMPANY, TOLEDO 7, OHIO

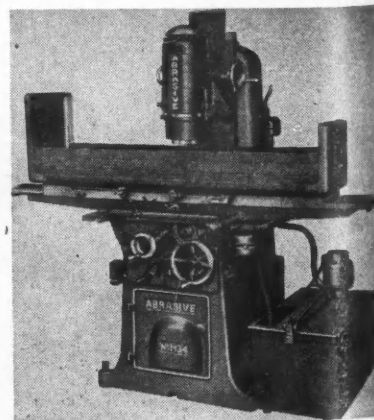
HALL



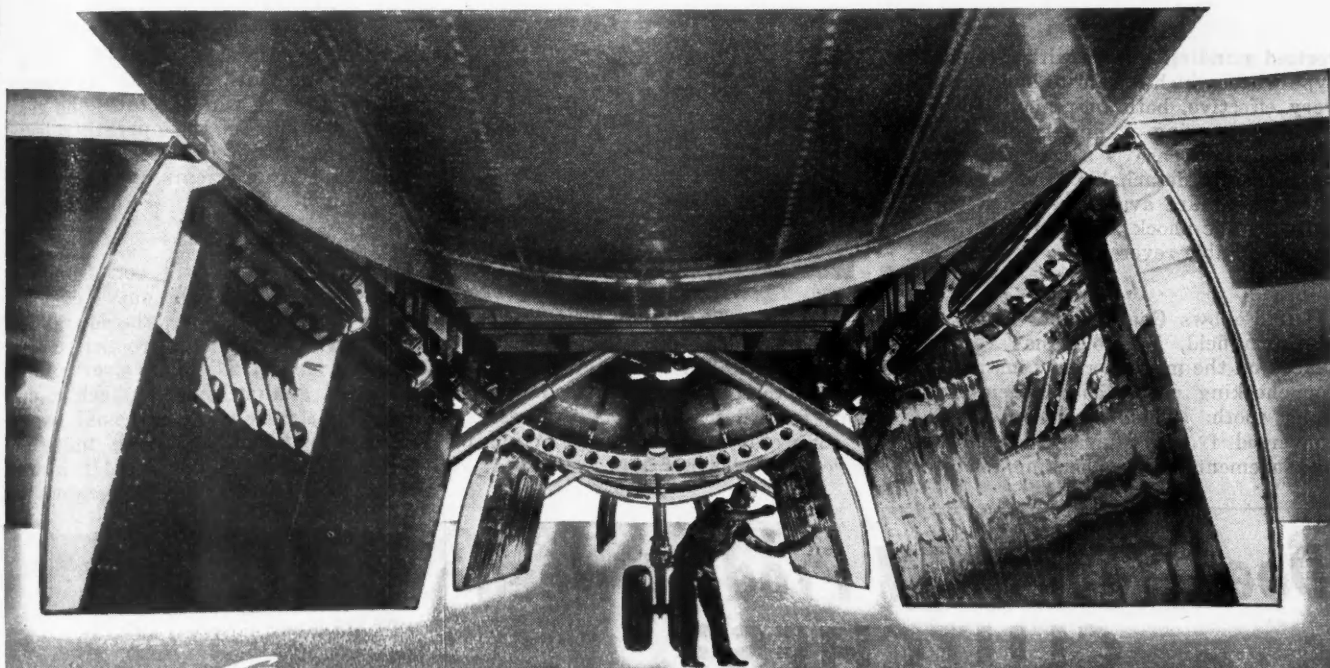
Lindberg all-purpose furnace

dered metals where each piece may weigh as much as several hundred pounds. Also, handling work in and out of the furnace has been made easier by the use of efficiently designed loading and unloading platforms. Furnace shutdowns are forestalled by the use of Globar type heating elements that are quickly replaceable.

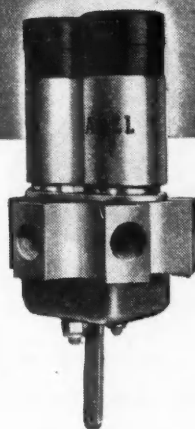
ABRASIVE MACHINE TOOL CO., East Providence, R. I., has recently announced a new vertical spindle surface grinder, No. M34. The design of this machine is a departure from previous models and incorporates a powerful motor (Turn to page 54, please)



Abrasive M-34 vertical spindle surface grinder



Open in $\frac{65}{100}$ of one sec!



Little wonder that Boeing, famous for advanced engineering, selected ADEL's Solenoid 4-way Pneumatic Valve (No. 13381) for opening and closing the Boeing B-29's huge twin bomb bay doors. Their tests showed that electrical operation required 20 seconds for opening while the ADEL air valves (operated by compression and tiny air bottles) did the job in $\frac{65}{100}$ th of a second; similarly, closing which required 30 seconds is now done in 1.4 seconds! Add to this speed the fact that the new system affords

weight savings of nearly 200 pounds plus reduced vulnerability due to solenoid operation without long bulky cables, and you'll see why other aircraft manufacturers are following suit. For complete information see nearest office. Over 500,000 ADEL hydraulic units comprising 300 types and sizes now serving aircraft, armament, transportation and marine industries. Known everywhere for Standardization, Design Simplicity and DEPENDABILITY.

For War (and Peace) Buy Bonds

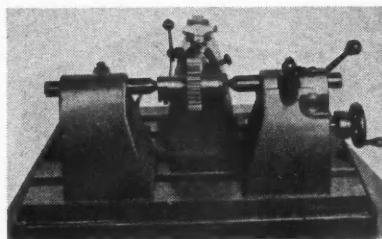
ADEL PRECISION PRODUCTS CORP.

ADEL

BURBANK, CALIF. • HUNTINGTON 17, W. VA.

Offices: 1411 Fourth Ave. Bldg., Seattle 1; 421 Mutual Home Bldg., Dayton 2; 802 Fisher Bldg, Detroit 2; 303 Wareham Bldg, Hagerstown; 914 Lexington Bldg., Baltimore 1; 353 International Bldg., Rockefeller Center, New York 20.

torized grinding spindle with a segment type wheel which is said to have proven very effective, both in removing stock and in securing a high-grade finish. Transmission case is a complete drive unit, readily detachable from machine. Two speeds are available, and a built-in hydraulic shock absorber eliminates shock of table reversal.



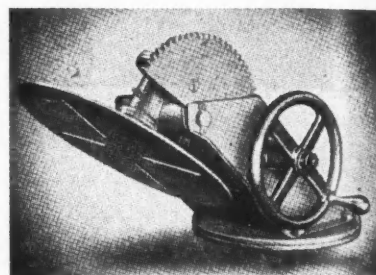
Fellows gear testing instrument

THE Fellows Gear Shaper Company, Springfield, Vermont, has recently placed on the market a new instrument for checking cone, tooth spacing and taper tooth. This instrument can be converted from the checking of cone measurement to the checking of tooth

spacing, as well as the checking of the taper of the tooth. The latter measurement is one that is found necessary in connection with the production of extremely accurate gears where full

face contact is necessary. The instrument is provided with an automatic indexing device which rotates the gear tooth by tooth as the operating lever is returned after making a check, and has a capacity for gears up to 12 inches pitch diameter.

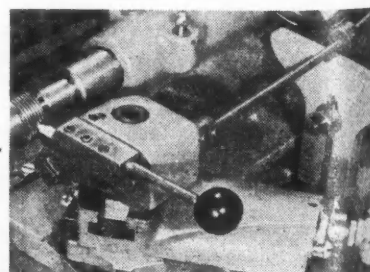
RANSOME MACHINERY CO., Dunellen, N. J., has brought out a compact bench model positioner, the Model 1H, designed to facilitate production and repair welding, assembly, overhauling, grinding, drilling, hard-surfacing, and similar operations on all small work. Its ability to handle small units efficiently makes the Model 1H a versatile machine for welding, assembly,



Ransome bench model positioner

maintenance, and repair shops. The capacity of this Ransome bench model positioner is 100 lb., with the center of gravity three in. above table. It has a tilting range of 150 deg., revolves 360 deg., and can be locked in position at any degree of tilt. The 16-in. table top is equipped with 9/16-in. slots. Swivel base is available if desired.

ALATHE tool holding attachment which snaps out a turning, chasing, or boring tool out of either internal or external lathe cuts at any predetermined point, is offered by The Foulk Engineering Company, Cincinnati, Ohio. Designated the Retract-A-Tool, the attachment is said by its originators to increase the possible speed of turning or chasing operations, particularly in blind holes or close to shoulders. As the retraction of the tool point is positive and instantaneous, the operator need only return the carriage to its starting point after the retraction occurs. Resetting of the tool point is accomplished by lifting the ball-end lever which shows above the top slide in the illustration.



Retract-A-Tool lathe attachment

Does Your NEW Product Need CLUTCHES?



If your new or improved products will benefit from better clutches, we can give you timely help:

As clutch building specialists, with over a quarter century of experience, we study your product designs and recommend the **BEST** clutches for your particular needs. We then have the facilities to produce those clutches on a basis that will strengthen the competitive position of your products — as to power, control, size, weight, service and price. **BRING YOUR CLUTCH PROBLEMS TO US** — By sending your specifications to us **NOW**, clutch needs can be met without unnecessary delay — when reconversion starts.

SEND FOR THIS HANDY BULLETIN ON POWER TRANSMISSION

It shows typical installations of **ROCKFORD CLUTCHES** and **POWER TAKE-OFFS**. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications. Every production engineer will find help in this handy bulletin, when planning postwar products.



Rockford Drilling Machine Division

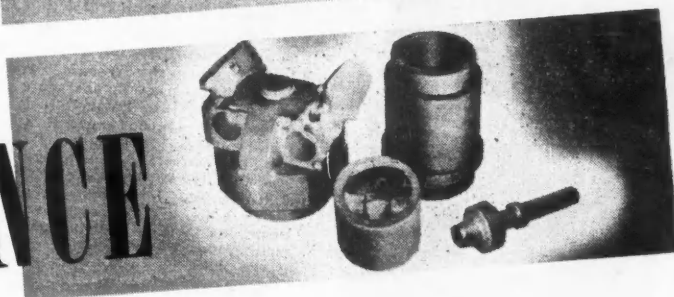
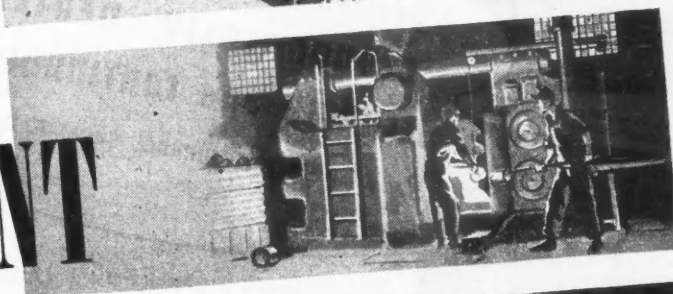
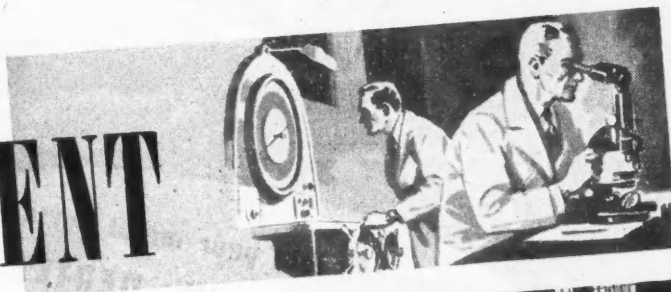
Borg-Warner Corporation

315 Catherine Street, Rockford, Illinois, U.S.A.



Forging Assignments Licked with "E's"

EXPERIMENT **E**QUIPMENT **E**XPERIENCE



Your product will face the keenest competition in history when this war is over. You are now studying ways to improve it to meet that competition. Forgings of steel or light metals may provide the answer, in weight saved, in added strength, in precision.

Tube Turns will welcome your inquiry. Complete laboratory facilities and a resourceful engineering staff are at your service. Our equipment is

capable of vast quantity production, with accurate heat treating under rigid control.

Because of the "E's" with which Tube Turns has handled many forging assignments, it is possible for us to suggest forgings for uses where, formerly, they would have been out of the question. Write to us about your problem. TUBE TURNS (Inc.), Dept. AA-2, Louisville 1, Kentucky.

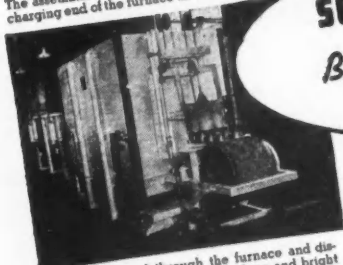
TUBE TURNS *Forgings for Industry*

EF FURNACES

For Every Industrial Heat Treating Process



The assemblies are loaded on a conveyor at charging end of the furnace as shown below



... and carried through the furnace and discharged—securely joined—clean and bright



**you can join your metal parts
ECONOMICALLY, NEATLY,
SECURELY and CONTINUOUSLY
By the ELECTRIC FURNACE BRAZING METHOD**

Aluminum, steel, brass and other assemblies are being securely and economically joined in EF brazing furnaces.

Products which otherwise would be difficult or expensive to make in one piece are being made in several pieces and brazed.

Products requiring several stampings joined or requiring screw machine parts, forgings and stampings to complete the unit, are being neatly, and economically joined, right in the production line.

Strong, leak-proof joints are made and the completed units are discharged from these furnaces—clean and bright. Any number of joints in the same product or any number of pieces can be joined at one time.

Investigate This Process for Joining Your Aluminum, Brass, Copper or Steel Parts.

We will be glad to put samples of your products through one of our furnaces to show you the results you can expect, and give you an estimate on the cost of the equipment to handle your product.

Send for printed matter showing various types of EF brazing furnaces.

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces—For Any Process, Product or Production

FURNACES OIL, GAS or ELECTRIC

For Every Heating and Heat Treating Process

Aluminum Brazing
Annealing
Billet Heating
Bright Annealing
Bright Hardening
Copper Brazing
Controlled Atmosphere

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Quenching Machines
Ceramic Kilns, etc.
Process Heating

We Build the Furnace to Fit Your Job
THE ELECTRIC FURNACE CO.
SALEM, OHIO



Aircraft Industry in '44

(Continued from page 17)

industry in 1943, the lowest for any industry producing war materials. Interim reports by individual companies on 1944 operations show the trend to be continuing.

The production pace was maintained in the face of constant changes in design necessary to meet ever changing tactical requirements and to maintain performance superiority over the enemy—emphasizing the flexibility of the aircraft industry. For example, one fighter plane underwent a change on the production line on the average of once every 40 hours. Even so, its production goals were met. Incorporation of these changes in the production line was a task of major proportions.

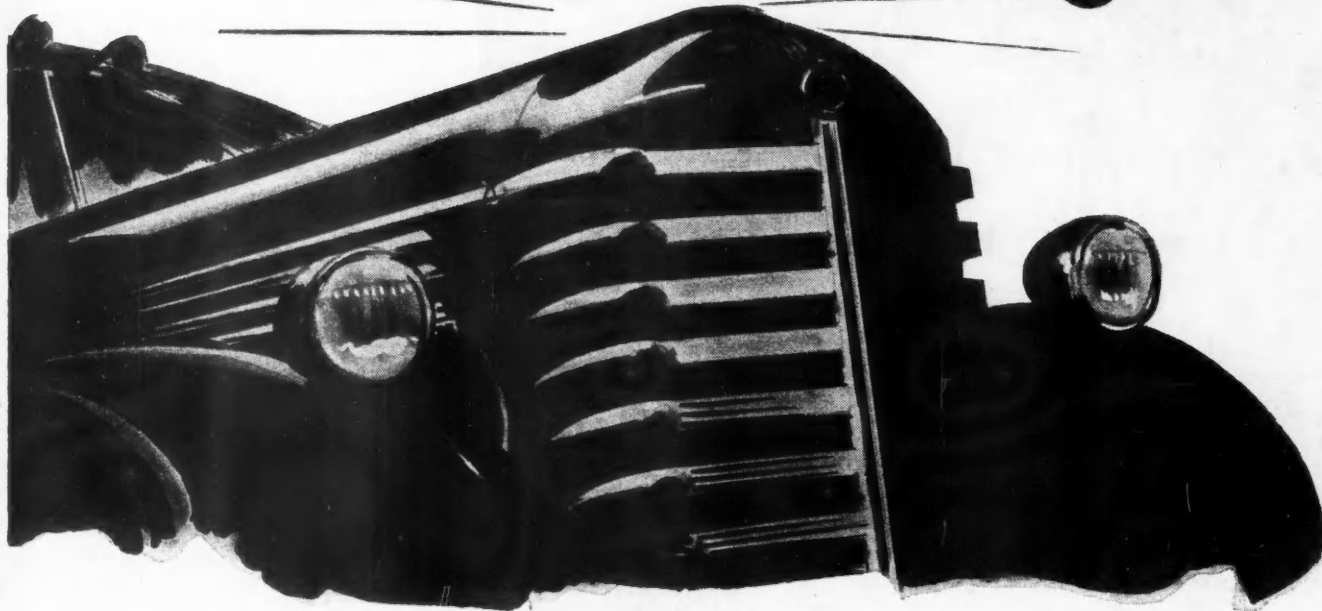
Greater speed and maneuverability, more armor and increased fire power were added to America's fighting planes during the year. One model, the B-25 medium bomber, now carries 14 machine guns and a cannon, making it the most heavily gunned ship of its type in the war. The machine guns fire at a rate of 800 rounds per minute giving this ship a potential .50 cal. fire power of 11,200 bullets a minute.

Perhaps no other industry has contributed so much to the design and development of major war weapons. Aerodynamic refinements with new shapes for wings, fuselages and tail surfaces, reduced drag and increased the speed of our fast and hard-hitting bomber-fighters. More power, longer service life and increased reliability were added to our aircraft engines during the year through improved cylinders, better fuels, lubricants and refinements in supercharging. The weight per combat horsepower has been reduced about 40 percent during the past three years.

The past year also has seen the veil of secrecy lifted further on many new developments in radio electronics that are enabling pilots to bomb through the overcast and to "sight" unseen enemies. However, the most spectacular development announced during the year was the first practical application by the Allies of jet propulsion to aircraft. Capable of super speeds, the jet plane was made possible through the development of the gas turbine.

During the past year, the trend has been increasingly toward heavy bombers, looking forward to the longer-ranged Pacific war. While all types of heavy bombers have been further emphasized, the most sensational developments have come in the announcement of the B-29 and B-32. These planes carry significance beyond the mere fact of long range bombing. Literally, they can span the world—and it was revealed that the 20th Air Force has been formed for just that purpose. While it is concentrating on the Asiatic theater right now, it is under the direct command of the joint Chiefs of Staff and available for use in any section of the world, requiring only the usual amount of notice to shift its attention.

**"...going to put an
Aluminum Engine
under that hood"**



"There's no sense in toting a lot of useless weight around. Looks like a logical spot for an aluminum engine," an opinion convincingly confirmed by tests on "aluminum engines" and aluminum engine parts by Alcoa's testing laboratory and outside manufacturers.

No idle dream, this aluminum engine. It has

spent hundreds of hours on the test block, and is now slated for road testing. Alcoa Aluminum Alloys have proved to be an excellent means of cutting over-all weight, improving engine performance and efficiency.

ALUMINUM COMPANY OF AMERICA, 2110 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN ALUMINUM



Airbriefs

By Henry Lowe Brownback

The Little Fellows

When I was a youngster I had a chance to visit with Alberto Santos

Dumont in Paris and to see his little dirigible balloon. Later I became highly intrigued with his little high-winged "Demoiselle" monoplane which was, at the time, the smallest airplane which

would fly. It was built almost entirely of bamboo and was so small that it was popularly called the "Flying Handkerchief." In fact, the job caused many heartaches as many of them were built and few people could fly them, the great exceptions being Santos-Dumont, Audemars and Garros. While most of us remember the two-cylinder edition best there was an eight-cylinder engine driving a very tricky propeller through a wide flat belt and idler. Here both the engine and the pilot were at the level of the axle and the propeller shaft was in the top wing.

While small motor cars and little boats have never made a hit with the American public mainly, I believe, because the average American has a power complex and feels much more important if driving something big as well as loving the exhilaration of controlling great bursts of mechanical power, his wife insists on keeping up with the "Joneses" and he has had the money to foot the bill, I feel that the future of the small airplane, and I mean SMALL, is not as dark as it seems at times because the young people who do not have much money are the ones who want to fly and the income tax man is going to be rough on our incomes for some time to come. So if these young people are going to fly at all it must be done at extremely low cost.

Now low cost can be achieved in one of several manners. We can have the "fly yourself" rental plane, the flying club or the small private plane. Fly yourself is a good plan but it does not have the thrill of owning a little job about which you can putter and fuss when you are not flying. The flying club is another name for partner-ownership and, while it may sometimes work, I have found that owning something in this manner is almost never satisfactory. The third alternative is the small plane selling for well under one thousand dollars and being so small and light that it can be stored cheaply and handled entirely by its owner.

The more I have thought of this last alternative the more convinced I have become of its practicability in spite of past experience. Mignet in his "Sport de L'Air" makes a convincing appeal for his formula of the 100 kilogram or 220-pound airplane and I only wish that I had the space to print the translation of his impassioned and logical appeal for the light plane. Marcel Leyat has gone thoroughly into the "5 HP of the Air." Our own Ed Heath built several good little jobs driven by a motor not primarily designed for aircraft and there have been several other little planes which have given a good account of themselves in nearly all countries.

As far as the plane itself goes, I believe that an application of many of the safety features worked out in the past few years will eliminate most of the danger inherent in stalling, but there are other defects to be overcome. If the light plane is made large enough not to be very quick on the controls it

(Turn to page 60, please)

28 YEARS OF "STOP" ENGINEERING



*Built Into Every
Brake Segment
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**PRECISION
CONTROL**

an important
factor in long-life
Grizzly Brake
Lining.

Far-advanced production techniques...precision control...built-in safety and long life, all these you take for granted in the "finest product of the brake lining industry"... Grizzly. Take advantage of the Grizzly organization's 28 experience-packed years of making better, safer brake linings. Send for free book, "Building UP to a Name". Grizzly Manufacturing Company, Paulding, Ohio.



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GRIZZLY
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BRAKE LINING

Why HANSEN

COUPLINGS

are so widely used

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THEY'RE EASIER TO HANDLE,
FASTER, LONGER LIFE,
CUT DOWN COSTS

SPEED UP PRODUCTION . . .

Hansen Couplings are first choice in all types and sizes of plants throughout the world because of their remarkable performance under every conceivable condition. • Simplicity in design means faster and easier operation, greater production, less cost, less trouble, longer life. • Hansen Couplings will take pressures from 2 ounces to over 10,000 pounds without leaking. • They take rough treatment like a major because no parts are exposed, there's nothing to bend, jam or freeze. • Simplicity in operation is one Hansen feature that saves time, a lot of time. For instance, with a Hansen Air Coupling you merely push plug into socket, it is connected, locked and air is automatically turned on. To disconnect, merely slide sleeve back, it is unlocked, disconnected and air is automatically turned off.

There's a Hansen Coupling made for air, oil, grease, gasoline, oxygen and acetylene. Send in for free industrial catalog.

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will have such a low unit loading that it will float badly and be bounced about considerably by rough air close to the ground in anything but the lightest breeze. These defects can and will be overcome.

The worst failing of the small, light plane has been the engine and many of them have been fitted with all sorts of conversions of motorcycle engines, out-board engines and small motor car engines as well as some pretty poor specimens of aircraft engines made to a price.

I built or designed several light engines and played about with most of the others and from years of experience

I believe that the minimum engine which will give day in and day out service is a three-cylinder radial or a four-cylinder opposed or in-line four-stroke engine, or a three-cylinder two-stroke engine. I also believe that extremely high engine speeds should be avoided with a maximum of about 3000 rpm for geared and 2500 rpm for direct engines.

The worst condition the light engine builder has to face is that of overloading. The designer of a big airplane provides for a cruising power of not over 65 per cent of maximum but, so far, the light plane builder has invariably tried to put an engine having a

maximum output of 30 hp into a 60 hp airplane. When I learned to fly the old Wright, the ship flew when the engine gave its maximum power and did not fly when it dropped 100 rpm. This is dangerous but when you get a light plane flying at 1750 rpm and losing altitude at 1650 ft with a 35 hp engine rated at 1700 rpm, flying it across country is suicidal.

Part of this has been due to overweight small engines. Forgetting the two-cylinder opposed engines, which are bad for many reasons, let us look over a few of the many light engines which have been built and mixing a dozen of them together, two- and four-stroke, we get a 27 hp engine which weighs just under 100 lb. In 1932 I proved to myself that one could build such an engine by doing just that and the result was a little radial job which had heavy all iron cylinders, low compression and a valve gear designed for low speeds and in spite of this it developed 30 hp at 1800 rpm. With modern materials, higher compression and careful design it would be easy to make a 30 hp engine to weigh about 75 lb and not be too expensive. With such a power plant the 250 lb plane becomes practical and would have plenty of excess power for climbs. I speak of my experience only as an illustration as anyone who has built good light engines can do the same thing.

I think that the biggest drawback at present to a good light plane is not the lack of "know how" but the fact that, in attempting to do it, if you miss your guess you lose a great deal of money and if you do a fine job you make almost nothing out of it after you get through paying taxes. As long as the odds are against the making of substantial returns on projects having a good percentage of risk there is little incentive to start new things.

Accidents

A most illuminating survey has been made public on the causes of accidents in both private aircraft and those used on scheduled operations. This survey covers a period of some three years. It is astonishing to see charts which show that structural failure of the engine itself is the second greatest factor and that this occurs far oftener in non-carrier operations than in carrier operations, while the most common cause of failure is the ignition system, the failure of which is a dozen times as great in carrier as in non-carrier operation. There is very little magneto failure in either case, most of the trouble occurring in the spark plugs with the harness as a second factor. This is very interesting as one of the major problems in a small engine is finding the installation room for the accessories and their drives without unduly complicating the engine and the almost total absence of magneto failure

(Turn to page 62, please)

30 YEARS' EXPERIENCE

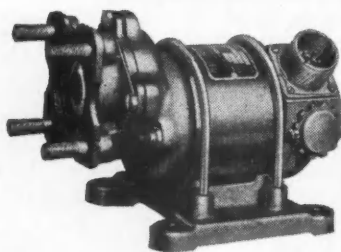
in small MOTORS...

As the result of long experience we wish to emphasize this fact: that close cooperation between product manufacturer and motor builder right from the start results in these important advantages:

1. Correlation of product and motor design to provide a thoroughly integrated unit essential for top performance.
2. Frequently product design suggestions can be made that will not only reduce product weight but will improve compactness and appearance.

Our experience covering all types of special application fractional horsepower motors is available to your engineering department.

THE LAMB ELECTRIC COMPANY
KENT, OHIO



THOROUGH ENGINEERING is the basic factor behind the successful operation of this aircraft fuel pump motor and many other special application motors we have designed and built for all types of equipment.

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SPECIAL APPLICATION MOTORS
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Plastics have been so thoroughly identified with modernity of designs in the minds of your customers, that they will judge the up-to-datedness of post war products in some extent according to the amount of plastic used in the construction.

They will be looking for plastics in your new cars!

One way to satisfy them is to use colorful, cleanable, hard surfaced Formica



sheets for the interior of your bodies.

There is a very wide range of effects to select from, and they can be had to harmonize with any decorative scheme you choose. This interior material is easier to clean. Grease can be removed with solvents, dust and dirt with soap and water.

Formica is easy to install; it's good from the production point of view.

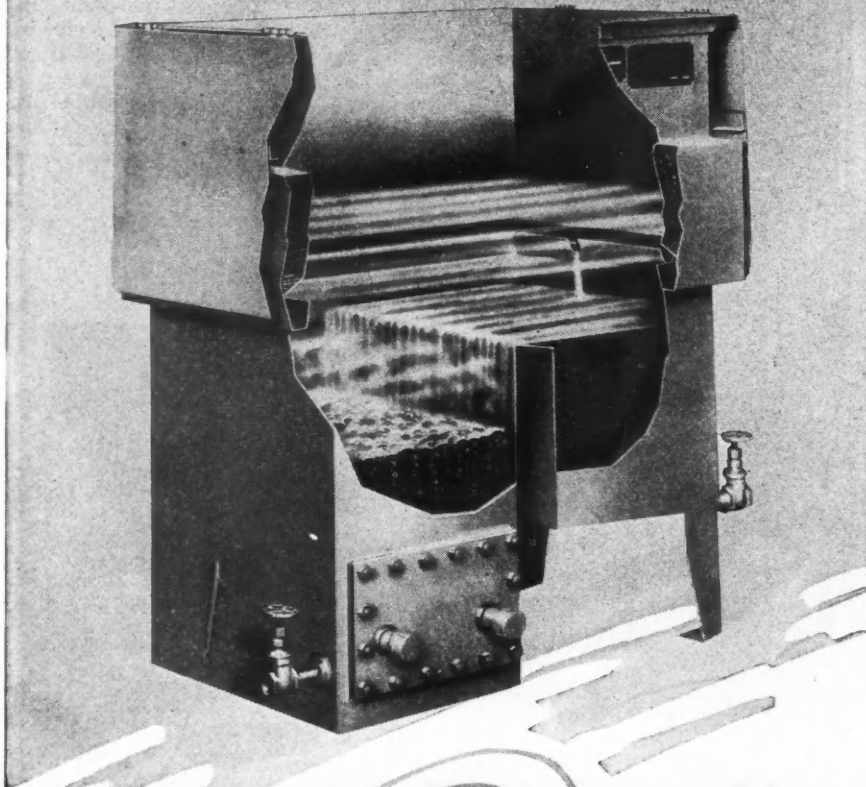
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February 15, 1945

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61

ARE YOUR *Degreasers*



AS MODERN AND EFFICIENT *as Your other* PLANT EQUIPMENT

Many improvements have been made in Detrex Degreasers during the past few years. Each has contributed to greater efficiency in metal cleaning and to increased economy in the use of degreasing solvents.

In your post-war planning, modernization of your metal cleaning operations will undoubtedly be given as much serious consideration as improvement of other production processes. Right now a Detrex engineer can bring you up to date on the construction and operation of the Detrex cleaning equipment now being produced. He will be glad to acquaint you with all the details which may apply to your particular situation. There's no obligation, of course.



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makes it seem to me that the two magnetos used only make for complication and weight and that the double ignition could be better accomplished by a single two spark magneto on these little jobs and still have the power and security given by two plugs per cylinder.

On the big engines stuck exhaust valves gave the greatest number of structural failures, with pistons and rings second and master rod bearings third, while in the light engine broken exhaust valves came first with broken crankshafts second, cylinder barrels third and cylinder heads fourth. The high percentage of broken crankshafts can be attributed to the fact that these little engines are, for the most part, in-line engines with shafts finished only on the bearing surfaces and having taper and key prop hub mounting. The large engines are radials with the shafts finished all over and spline shafts for the prop mounting. While the valves in the big engines stuck badly, they did not break as they did in the little jobs. It is my opinion that the valve breakage in the small engine comes from overheating of the stem near the head.

Ettore Bugatti had all kinds of trouble with both his motor and rail cars breaking valves until he adopted a scheme, once used here, of inserting a copper rod in the valve stem. I once had a Ford Model A with a big downdraft carburetor and when I opened her up on the mountains I had plenty of valve trouble but a set of Silchrome valves with copper cores cured it entirely. I have never tried them in an air-cooled aircraft engine but from other experiences it seems that they might help in the little jobs where price prevents the use of sodium cooling. Of course cylinder and head failures are just bad design or bad material unless the cylinder bases are strained by the hold-down bolts. As the readers of *Airbriefs* know, I have always favored the small, simple radial engine for light aircraft because in this type of engine the compact structure uses little material and it costs less to machine the shorter parts. This permits, I believe, the overall machining of parts which would have to be left with forged or mold finish in other types unless, of course, the designer gets complicated ideas and copies the complications of the larger radials which would run his costs way over those of the in-line type. The construction of a large engine entails much complicated machining, but there is no reason for a light aircraft engine to be more complicated than a motorcycle engine.

A Revolution

I doubt if the full realization of just what jet propulsion may mean has struck most of us in the industry. It appears likely that the majority of the
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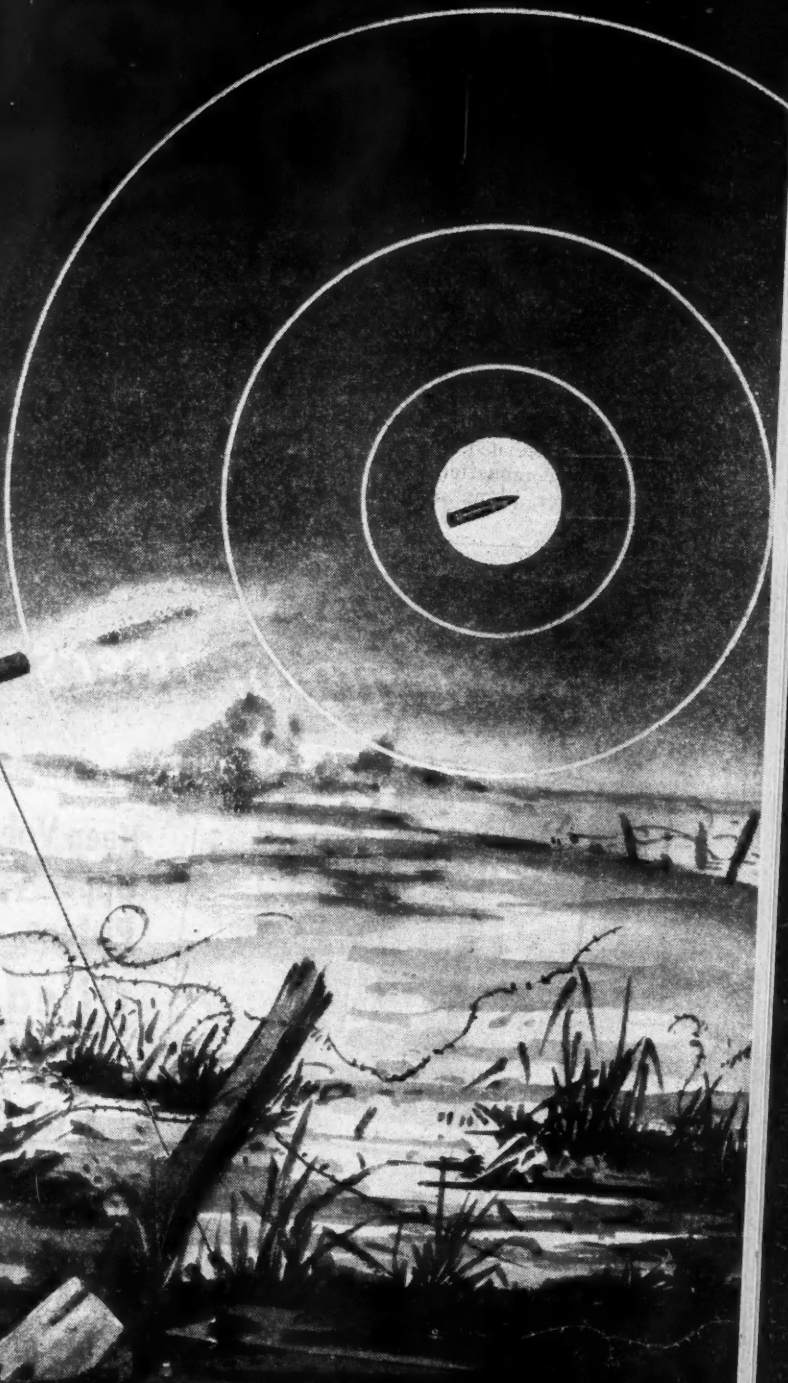
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40 MM
PROJECTILE

NEW BRITAIN MACHINED

At this very moment Allied artillery shells are reaching their targets all over the world with deadly accuracy . . . an unequalled performance made possible by American men, women and machines producing precision-built firing power and ammunition. • New Britain Automatics remain on the job in turning out essential parts for projectiles and other war materials and equipment...machines designed to withstand present day production demands and engineered to stay accurate . . . now and postwar. • New Britains produce more... better and faster...for less.

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NEW BRITAIN-GRIDLEY MACHINE DIVISION

fighter craft of the future will be jet propelled. This means that high octane gasoline will not be necessary for this type of craft nor will it need the oceans of lubricating oil used by the reciprocating engines en masse. Instead of crankshafts, finned cylinders made from forgings, and finned cylinder heads cast or milled from forgings, pistons, connecting rods, bearings, ignition systems, sodium cooled valves, cams and valve gear and all of the delicate parts which go to make the modern aircraft engine, we will have something, as far as machinery is concerned, resembling a turbine and a combustion chamber. The future power plant may be the ap-

paratus now used by the Germans in their rockets. All of this will cause a revolution of no mean proportions in the engine and fuel industry and in pilot and mechanics' training for fighter craft.

It also appears that important changes are in line for the big gasoline engines. At present much of the power contained in the fuel goes to make a lot of noise, a very hot exhaust pipe and a trail of flame. If this heat could be converted into power in such a manner that the mechanism for doing it would not weigh more per horsepower than the original engine a tremendous saving of fuel and a lot of ad-

ditional payload would result. Some steps have been taken by the exhaust driven turbo-supercharger, but I am told that in the not-too-distant future we will have high-powered engines composed of a high pressure reciprocating unit and a final low pressure turbine in one engine taking the most out of the heat energy in the fuel burned. There have been and will be great problems to solve but it is certain that the long awaited revolution in engine building has gotten under way.

How Bellows Are Fabricated

(Continued from page 38)

or brazing on special flanges, or end plates, or other attachments. Such parts are fabricated in the punch press department, screw machine department, etc., and delivered to the assembly department for installation.

For examples of the precision character of Spring-Life bellows, consider some of the specifications that are being met in regular production. For one thing, it is claimed that the bellows will withstand 600 million cycles of flexure without fatigue failure. Bellows for an altimeter control mechanism are made with extreme sensitivity of spring-rate and with zero hysteresis. This bellows is calibrated with a manometer to deflect 0.015 in. per 1000 ft of altitude, plus or minus 0.0004 in. Another small bellows responds to pressure of 0.009 lb and yet withstands hydraulic pressure of 1000 psi. They have been measured and been found to have a hysteresis of less than 1/12,000,000th of an in.

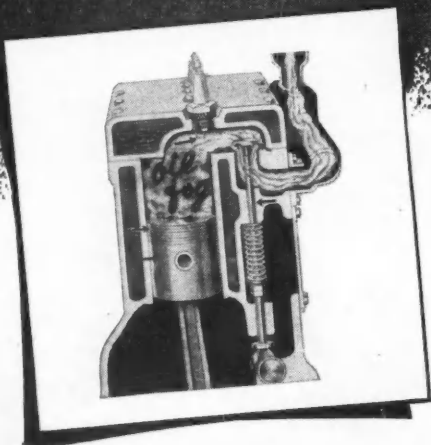
Although at the present writing the facilities of the company are strained to beyond capacity by war work, the postwar outlook holds promise of great service to the widespread automotive industry. Flexibility of thinking and of facilities make it possible to consider the organization as an adjunct of the development department of any producer in the field. Thus they can tackle problems leading to the design of elements required in enormous quantities or for special application where perhaps only one or a small number of special units may be required.

Tungsten Carbide Commutator Saws

SUPER TOOL CO., Detroit, Mich., makes available a line of solid tungsten carbide commutator saws ranging in size from 1/4 in. to 1 in. in diameter. They can be supplied in thicknesses from .015 in. up and in hole sizes to meet specifications.

Exhaustive laboratory tests and the performance of these saws on actual jobs are said to indicate that tungsten carbide is an excellent material for cutting the precision grooves in commutators. The use of Carbide in this work eliminates the filing operation often necessary after the use of conventional tools.

advise motor users:



**Keep Valves, Guides,
Upper Cylinder,
Pistons, Rings
Oiled
thru
Carburetor**

by treating your gasoline with

LUBRI-GAS

there's NOTHING else like it!

No mechanical system has ever been invented that assures constant, adequate lubrication of valves, guides, upper cylinder, pistons, rings. That is why sticky valves, burned and pitted valve seats, worn rings, and carbon and gum accumulations in upper cylinder are usually the first symptoms of motor trouble. Lubri-Gas Laboratories have developed an exclusive method of chemically processing 40 SAE lubricating oil, so that it enters the combustion chamber, through the carburetor, as an oil fog, and coats all upper cylinder parts with a film of clean oil. The results of this better lubrication are more power, more mileage per gallon, more pep, less wear and repair, freedom from carbon and gum and prevention of overheating and oil pumping. Now when it is so important to keep equipment in operation and out of the repair shop, LUBRI-GAS is indeed a God-send!



Send for Free Lubri-Gas File. Contains complete information about this modern motor fuel treatment.

LUBRI-GAS

221 No. LaSalle St.
Chicago 1, Ill.



TRADEMARK

Cleans and Lubricates as It Powers the Motor

New Products for Aircraft

Aviation Battery Tester

A high-rate discharge battery-tester has been developed by Lanagan and Hoke, Philadelphia, Pa., for ground use for conducting high-rate-discharge tests on Army and Navy aircraft batteries. The tester incorporates 5 calibrated nichrome resistors, capable of dissipating up to 350 amp. on batteries of 12 or 24-volt potential. These resistors are selected by means of 5 trust-type terminals. They are connected to the bat-



Lanagan and Hoke battery tester

tery to be tested by means of two heavy cables.

Two models are available, Model 667 which is equipped with a combination voltmeter and ammeter, and Model 666 which has a voltmeter in place of the combination instrument.

High Altitude Aircraft Ignition System

A new low tension aircraft ignition system has been developed by the Scintilla Magneto division of Bendix Aviation Corporation. The new system makes possible higher voltage sparks at the spark plugs while replacing a high tension current of more than 12,000 volts with a low tension current of comparatively few hundred volts. It is said to make possible efficient operation at higher altitudes than ever before, easier control of the electric current, less interference to radio reception, and greatly increased resistance to moisture and other atmospheric conditions.

Radio Range Orientator

Aviation Associates, Chicago, Ill., has announced a new type radio range orientator and turn and heading computer. The Dean radio range orientator gives the pilot his bisector heading, drift corrections, heading to fly to reach the nearest beam leg when get-



Dean radio range orientator

NITE HAWK

AERO-STARTER

ALL WEATHER PLANE STARTER



Here is dependable starting power in coldest weather. The Nite - Hawk Aero -

Starter provides ample, continuous power for starting airplane engines, including those in heavy bombers, at any temperature.

A portable engine-driven power plant, it operates independently of other power sources. Also furnishes power for testing turrets, circuits and wiring, landing gear, etc. Equipped with floodlights for night operations. Air compressor attachment for inflating tires available. Investigate!

Write for Bulletin NH12A



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INCORPORATED 1706 SO. 66TH ST., MILWAUKEE 14, WIS.
MFRS. OF PORTABLE NITE-HAWK AERO-STARTERS, SEARCHLIGHT AND FLOODLIGHT UNITS
ALSO DIESEL ENGINES AND DIESEL-ELECTRIC POWER PLANTS



MORE FIRING ACCURACY

BECAUSE OF

TORFLEX

BEARINGS

U. S. tanks are pounding their way to victory in all theatres of war and one of the component parts of this mobile fortress is Harris *Torflex Bearings*.

Battlefields are undoubtedly the greatest of all proving grounds for mobile military equipment, and it is on these battlefronts that *Torflex Bearings*, in connection with shock absorbers, are daily demonstrating their remarkable efficiency in cushioning shock and absorbing vibration.

Torflex Bearings have also helped immeasurably in increasing the firing accuracy of tanks by absorbing vibrations and steadying the tank when in action.

This is just one of the many vital war jobs *Torflex Bearings* are handling. The switch-overs, when peace comes, to industrial uses will be many and varied, and when released from our war efforts, we will again work with industry in the production of *Torflex Bearings* for peacetime products.



HARRIS PRODUCTS COMPANY

Specialized Rubber Engineers
and Sole Manufacturers of
Dufflex VIBRATION INSULATORS (MOUNTS)
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HARRIS

PRODUCTS COMPANY

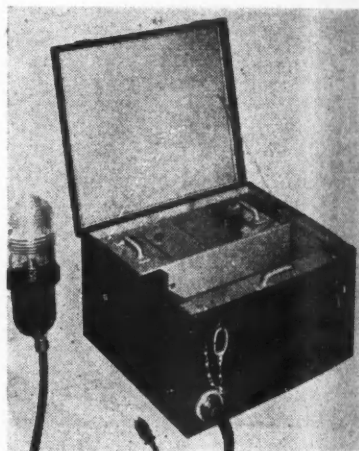
CLEVELAND 4, OHIO, U. S. A.

ting a fade-out signal, headings to fly during turn-around procedure on each beam leg, ship-to-station bearing, and station-to-ship bearing.

Four arms on the orientator can be set to coincide with the published beam bearings of the particular radio range being flown. The four bisector headings are then automatically indicated. The turn and heading computer is found on the reverse side. It contains a rotatable disc with index arrow and four sets of figures which answer many questions for the instrument pilot.

Portable Flashing Beacon

Originally brought out by Electronic Laboratories, Inc., Indianapolis, Ind., for identification signalling at military airfields, a lightweight, portable flashing beacon is of interest to all airports. It operates from 110 volts, alternating



Flashing beacon made by Electronic Laboratories, Inc.

or direct current, and utilizes a vibrator power supply to produce high-intensity, short-duration, intermittent light flashes. The same equipment is available for operation from 6, 12 or 24 volt storage batteries. The light is said to be visible, under normal conditions, for at least 20 miles at night.

Magneto Test Stand

Airplane Manufacturing & Supply Corp., North Hollywood, Cal., is introducing a new magneto test stand, the Amsco Model PA 905, which is designed to drive dual distributors with the magneto. Flange mounting magnetos with integral distributors may be mounted and tested at the required speeds. Magneto is directly driven and distributors driven are geared from the main drive. Single control permits speed changes—armature control automatically switching to field control after basic speed is reached.

Only 2 quick steps to set Explosive Rivets ... and it's a one-man job



1. Insert rivet in hole.

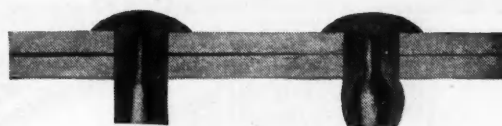


2. Apply heated iron to rivet head.

FOR BLIND RIVETING ... definitely! But, in addition, *wherever* there's a job that's hard to reach, Du Pont Explosive Rivets may save time and reduce costs.

Today, aircraft manufacturers are using Explosive Rivets on many jobs formerly finished with conventional rivets. Spots that are hard to get at ... places where design, intricate wiring or bulky instruments interfere with bucking bars ... awkward locations inside the fuselage, wings and stabilizers ... these and many more are "naturals" for Explosive Rivets.

Get complete information. Write for helpful manual giving all the details. E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, Wilmington, Delaware.



Push-fit holes are not necessary. Explosive Rivets have a charge extending the full length of the shank (*Above*). When fired (*Right*) the entire shank expands ... completely fills the hole and provides a strong, tight joint. The barrel-shaped blind head locks the rivet securely in place ...

DU PONT EXPLOSIVE RIVETS

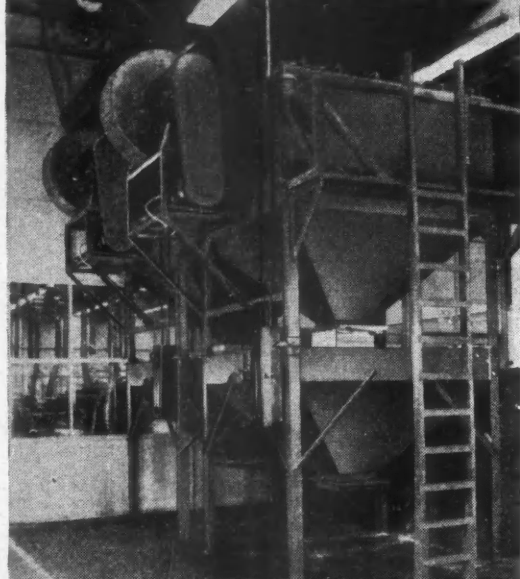
the only one-piece blind fastener



WE COLLECT THE CHIPS



for more propellers

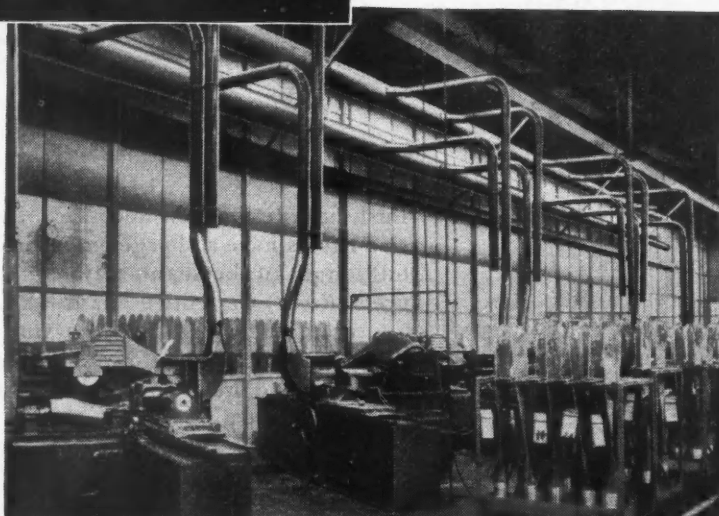


Above—Two 6A Special Airmat Dustboxes collect 12 cubic feet of Aluminum Alloy chips an hour from propeller blade profilers.

Below—Aluminum Alloy Chip Conveying Systems for 10 Propeller Profilers. Parallel exhaust systems to separate Airmat Dustboxes permit segregation of two alloys.

Here is an interesting application of AAF equipment to materials collection which does not directly involve a dust hazard. Airmat Dust Arresters segregate two different types of aluminum alloy chips for salvage in the propeller division of a large aircraft manufacturer. Since blades made of both alloys are worked on the same machines it was necessary to install parallel collecting systems, either one or both of which may be operated as required.

If you have a materials collection problem or a dust problem, AAF can help. Send for new edition of "AAF in Industry." There's no obligation!



Convair Production

(Continued from page 34)

B-24 has been reduced from \$238,000 each to \$118,500.

In building the section four years ago, it was constructed permanently in a buck. From here it was hoisted to a line for installation of hundreds of feet of wiring, tubing and numerous accessories and controls. This method of manufacturing developed a bottleneck, for it was found impossible to crowd enough workmen together to install the equipment in time to meet advancing schedules.

Planning engineers devised a greatly improved method of building it which resulted in substantial reductions in the man hours involved in its construction.

The section was still made in a buck, but was not permanently riveted. Along certain cleavage lines which separated the component into six panels, set up screws were inserted. After being hoisted from the buck, the section was broken down into six panels. These panels were then mounted on moving lines for riveting, drilling, and installation of wires, tubing and accessories. Installation work was greatly speeded up because employees had easy access to panels with sufficient room to work without interfering with others. Following this work, the panels are mated to form the nose section of the fuselage. Connection of wiring and tubing is then accomplished after the section has been permanently riveted. This final work is completed by a few employees as the sections progress down a constantly moving powered line.

Tooling has been one of the chief factors in the aircraft industry's vast output of planes. Several large groups make up the department in San Diego, including the tool and assembly planning section, tool design, tool and equipment control, jigs and fixtures, and tool and die manufacturing.

Simplification of tools and assembly operations has been the keynote of the entire organization. The policy of simplification was adopted early in the tooling-up program and has been stressed incessantly throughout our production experience. Aircraft require the highest perfection in construction, and the best skills in industry and science are needed to make them. When the war was thrust upon us, only a small percentage of our requirements for qualified workmen was available. The only solution was tooling, so accurate and complete that men and women with a minimum of training could fabricate and assemble the many thousands of planes on order.

The broad specifications for the tooling program were set up as follows:

- (1) Work will be accomplished in detail part wherever practical.
- (2) Complicated assemblies will be broken down into less complex sub-assemblies, and simple mating fixtures will be provided for assembling.

(Turn to page 72, please)

AMERICAN AIR FILTER COMPANY, INC.



449 Central Avenue, Louisville, Kentucky

IN CANADA, DARLING BROTHERS, LIMITED, MONTREAL, P. Q.

*Something New
in Engine Governors!*

the **CENTRI-VAC**

Constant Speed

Quick Acceleration

Easy Installation

News of a real improvement travels fast! Many already know about this new Holley CENTRI-VAC carburetor-governor, but this announcement will add further confirmation. This new CENTRI-VAC carburetor-governor, developed in collaboration with Mallory Electric Corporation, Detroit, combines many important and hitherto unavailable operating and installation features. Leading truck manufacturers recognize it as a definite improvement over anything previously used. Some installations are now available.

Low in cost, easily installed, it provides sharper and more positive control than velocity governors.

Controlling speed without surging, loss of power, or sluggish pickup, it insures maximum safety for power plant and vehicle.

HOLLEY CARBURETOR COMPANY

5930 Vancouver Avenue, Detroit 4, Michigan

HOLLEY

**AIRCRAFT • AUTOMOTIVE • MARINE
CARBURETORS AND ACCESSORIES**



- (3) Parts which cannot be coordinated will have #40 pilot holes established in one member only if the parts are thin and only two thicknesses. If the parts are heavy or of several thicknesses, the method will be to use drill plates on the assembly jig without holes in detail.
- (4) Drill plates will be $\frac{1}{4}$ in., containing bushings to attain a greater degree of accuracy.
- (5) All tooling will be of steel or steel and non-structural Masonite members.
- (6) Steel fixtures of the vertical tubular frame type will be utilized for flat assemblies. Trunnion stands will be rigid welded units in order to accommodate universal drilling, routing and riveting equipment.
- (7) Track mounted drilling units, routing units and riveting units will be provided as a standard set-up for all panel type

- assemblies such as skin-stringer assemblies, bulkheads or floor panels.
- (8) All production tools for C.V.A.C. use, of tools built by vendors for their use, will be built from coordinated tooling gages.
 - (9) All hole patterns will be established by master plates which will be at least $\frac{1}{2}$ in. thick and designed with bushings whose inside diameter is the same as the holes of the finished parts.
 - (10) All tool frame structures will be stressed per stress standards.

Our extensive tooling program, built after the above pattern, has made it possible to utilize thousands of unskilled workmen in building precision products.

In connection with building fixtures,

early in 1944 we constructed a Master Tooling Dock (for details, see Sept. 1, 1944, issue of **AUTOMOTIVE AND AVIATION INDUSTRIES**—Ed.), consisting of two units. The larger one is a steel framed structure, 60 ft by 15 ft by 10 ft, equipped with horizontal, vertical, and transverse steel straight edges. It is used for constructing three dimensional assembly fixtures from loft information in a minimum of time and to tolerances not possible with former methods of building fixtures. This fixture in which to build fixtures was invented by L. A. Bryant, Consulting Engineer for Consolidated Vultee. It has revolutionized the methods of building and duplicating fixtures and has been a great factor in speeding up tooling for new models.

The interior arrangement of the plant is a decisive factor in production. The principle of universal movement is applied not only to materials as they progress through the manufacturing stages, but also in one sense to plant layout. It has been a policy to keep the plant in style with the latest models being produced and the most recent techniques developed in their construction. This involves extensive re-arrangements as design changes are incorporated into aircraft, and as new tooling replaces former types.

Convair has been faced with a rather unique traffic problem due to the separation of our two San Diego plants, located about a mile apart. Plant 2, known as the Parts and Sub-assembly plant, fabricates detail parts and builds major assemblies. In specially designed equipment, large components are moved from there to Plant 1 to be mated and completed on final assembly lines.

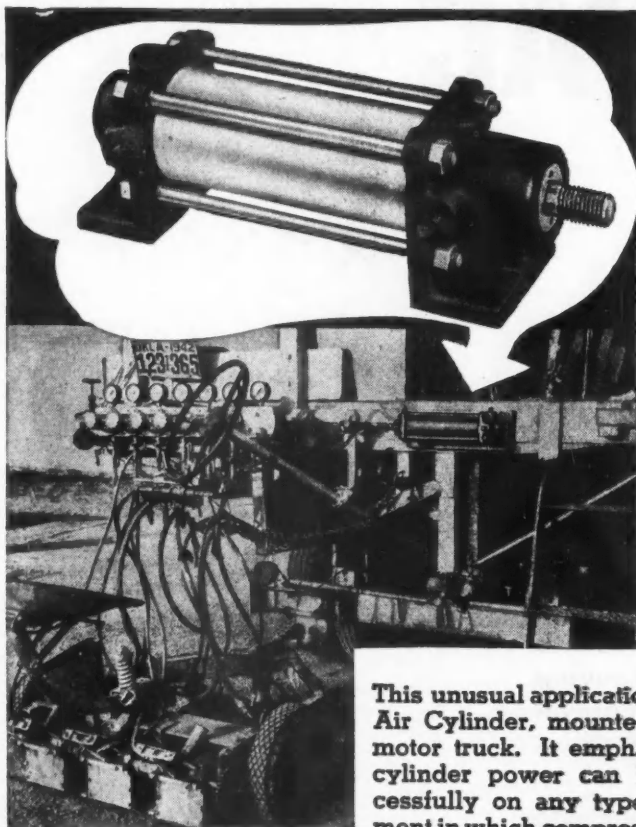
The movement of material and work in process by the transportation department averages 1,509,000 pounds each day. Investment in material handling equipment, including personnel transportation facilities, amounts to approximately \$650,000. It is apparent from these figures that handling materials is a major problem in a large aircraft plant and that reduction in movement becomes an important factor in lowering unit costs.

Until several months ago, shortages of material and parts ranked as one of the greatest obstacles to all-out production. Slowly, the condition has improved and although the problem has not entirely vanished, it has little effect now in meeting schedules on time.

The material department comprises several large groups. Raw material and parts are procured from over 2000 vendors, located in nearly every state. Currently, about 8000 active items are being purchased. Monthly commitments for one contract average around \$10,000,000.

By adjusting inventories on a 60-day requirement basis, reductions in inventories have been effected, with noteworthy improvements in unit costs. A

(Turn to page 76, please)



K-C Road Marking Units Use NOPAK Air Cylinders!

This unusual application shows a NOPAK Air Cylinder, mounted on the rear of a motor truck. It emphasizes the fact that cylinder power can be employed successfully on any type of mobile equipment in which compressed air is available.

In this Kelly-Creswell road striping unit, a Standard NOPAK Model A Air Cylinder, controlled by a 3-way hand valve, performs an important lifting and lowering operation. The compressed air is supplied by the same compressor which supplies the spray guns and other air equipment embodied in this unit.

Whether you build stationary or mobile equipment, NOPAK Cylinders of standard design can often provide vital pulling, pushing, lifting or clamping action to eliminate manual effort, speed up the operating cycle, simplify control.

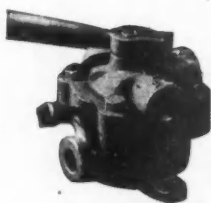
Write for Bulletin 87.

GALLAND-HENNING MFG. CO.

2774 S. 31st STREET

MILWAUKEE 7, WISCONSIN

Representatives in Principal Cities



NOPAK Valves

are engineered for positive accurate control of air or hydraulic cylinders. Hand, Foot, and Solenoid Models in a complete range of sizes.

NOPAK VALVES and CYLINDERS

DESIGNED for AIR or HYDRAULIC SERVICE

A 4613-1/21-A

**LEADS
IN PERFORMANCE**

**LEADS
IN APPEARANCE**



LEADS IN PERFORMANCE

New, modern features make possible the superior finishes and high production that give the Landis Tool Centerless leadership in performance. These include: Faster stock removal to close limits and fine finish by rigid support of work in guide that extends up to center line of regulating wheel spindle • Simple rheostat controlled adjustable speed drive •

Screw traverse adjustment of regulating wheel base for rapid, accurate wheel alignment • Tilting regulating wheel base for through feed grinding • Swiveling regulating wheel base for grinding tapers • Quick, easy setup of single work rest for parallel or tapered work • Single, convenient valve at operator position controls coolant for grinding and dressing.



LEADS IN DESIGN

New and advanced features have given LANDIS TOOL immediate leadership in centerless grinders. These include specific advances in the design of grinding wheel base, grinding wheel truing device, work rest, regulating wheel and hydraulic system, lubricating system, coolant system and electric controls. Some of the outstanding features are: Wheel dressed by hydraulic traverse of rigidly mounted diamond •

Hydraulically controlled grinding wheel dresser accessible from operator position. Earphone to determine when diamond is in contact with wheel • Conveniently grouped main controls with master stop button for instantaneous control • Three position selector switch controls machine for "setup", "dress" and "grind" • Grinding wheel base adjustable to compensate for wheel wear and varying work diameter.



For complete information on the No. 12 Centerless Grinder, write for a copy of Catalog T44. Landis Tool Company; Waynesboro, Pa.



Closeup of grinding wheel shows hydraulically controlled diamond dresser with earphone to determine when diamond is in contact with wheel.

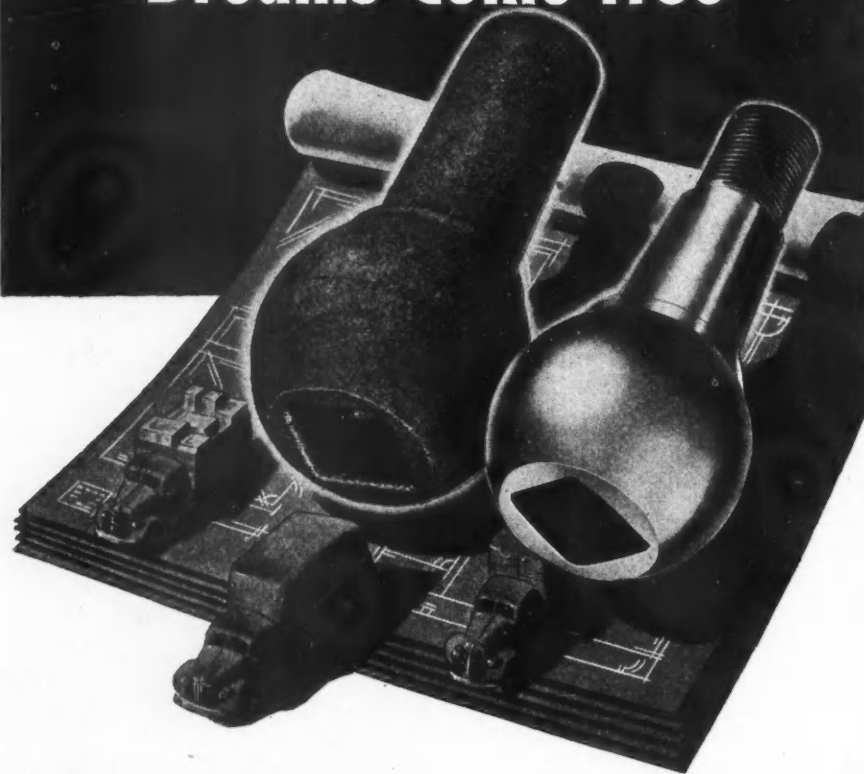
16



WAYNESBORO, PENNA.

LANDIS TOOL
Company

We Make Your Blue Print Dreams Come True



Consider this example of Western skill that assures you precision parts at quantity production economy

Designers who planned this torque rod ball for heavy-duty trucks demanded extra-rugged strength to take a beating in war service and super-smooth finish to prevent binding or wear on its composition mating piece. So we turned and ground it from a rough forging of SAE 4340 steel, over 5" long, 3" diameter at the ball, better than meeting the specification of 8-12 micro inches profilometer reading on ball surface, a .004 total tolerance on diameter, accurate taper on shank and class three fit on threaded end. Down to precision parts of watch works size, you can depend on Western skill and ingenuity to produce them — with ultra-exactness, speed and economy. Prompt attention to your inquiry — it pays you to write us.

Western Complete Service — Special precision screw machine products to specifications. Capacity range, $\frac{1}{16}$ " to $4\frac{5}{8}$ " round. Complete equipment for all types of secondary and processing operations — precision grinding, heat-treating, hardening, penetrating.

Aircraft Products Division

Western Automatic

Machine Screw Company

724 Lake Ave., Elyria, O.



Precision Parts and Assemblies Since 1873

year ago, stocks of material and parts were valued around \$30,000,000. Today, that figure has been slashed in half, while at the same time production is greater than when excessive stocks of some materials were carried.

This condition has been made possible by scheduling the arrival of purchases. As the market has eased up in numerous items, it has been possible to adjust requirements to a lower level without risking the possibility of delay in delivery of completed airplanes. Installation of better inventory controls has also contributed to the reduction in stocks.

The traffic department is responsible for handling receipt and shipment of freight. During a recent twelve month period, over a quarter of a billion pounds of rail shipments were handled. To assist in coordinating this immense flow of material over the nation's railways, company traffic representatives, like range riders, are stationed at strategic points throughout the country. If a shipper encounters difficulty in obtaining cars, these men help round up the necessary number. In the event loaded cars are delayed, traffic representatives pry them loose and prod them on their journey. Daily, the traffic department receives data regarding the status of cars enroute to the plant. Occasionally, in the case of vitally needed material, a freight car is intercepted while in transit and routed by express to assure its arrival on time.

This close control over movement of raw materials and sub-contracted parts beyond the area of the plant itself is one of the primary reasons for the smooth and high production operation of the San Diego plant. The scramble for materials which resulted during the early days of the all-out production of aircraft has disappeared. The pool of material which formerly accumulated at the head of the plant is receding as more of it is being channeled directly into production lines. This condition has a more significant effect on production than is generally realized particularly on costs.

Two Rubber Companies Buy Electronic Patents

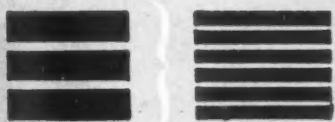
Patents covering electronic vulcanization of rubber and other materials have been purchased by the B. F. Goodrich Company and the Firestone Tire & Rubber Company. The patents were originally granted on discoveries made by R. A. Dufour and H. A. Ledue of France, and by E. E. W. Kassner of Switzerland.

In making the announcement the rubber companies stated that the patents would be made available both to the rubber and plastics industries on a reasonable basis, believing that this policy will speed electronic development ultimately making available to consumers improved rubber and plastics products at lower costs.

Here's How HIGH-SOLIDS Lacquers Cut Finishing Costs

It's not the cost per gallon that determines finishing costs—more important to consider is the finishing cost per unit!

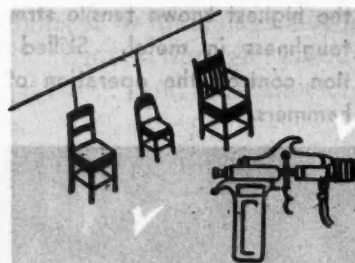
High-solids lacquers mean thicker, fewer coats and many other savings that cut production costs drastically. Here's how:



High-solids nitrocellulose lacquers deposit thicker films at spraying viscosity, giving you the same finish with fewer coats.



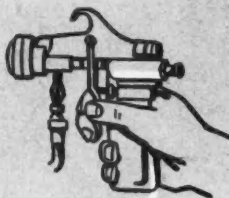
You save valuable floor space with high-solids lacquers. The fewer number of coats, the smaller the area needed for finishing and work in process.



It's easy to apply high-solids lacquers by any of the usual commercial methods... spraying, flow-coating, tumbling, dipping, or roller-coating.



Nitrocellulose lacquers are still the fastest-drying finish... in minutes at room temperature. No expensive baking equipment is needed.



One of lacquers' biggest advantages is the ease with which any scratches or imperfections in the finish can be retouched or repaired.



Ask your supplier for complete details. Hercules makes no lacquers... concentrates on production of highest-quality nitrocellulose.

HERCULES

HERCULES POWDER COMPANY
INCORPORATED

960 Market Street, Wilmington 99, Delaware

CL-52

New Products

Two-Speed Hydraulic Foot Pump

Lyon-Raymond Corp., Greene, N. Y., offers a new two-speed foot pump for pressures up to 10,000 psi. An advantage of this new pump is the automatic change speed feature. The pump has two pistons—one a high speed, low pressure piston, the other a small, slow

speed, high pressure piston. Up to 1000 psi pressure both pistons pump oil, but at 1000 psi the high-speed, low pressure piston automatically cuts out and higher pressures (up to 10,000 psi) are developed by the small high pressure piston.

The pump is a self-contained type, designed for continuous performance.



Lyon-Raymond foot pump

It can be furnished with a base suitable for mounting or with an auxiliary base allowing it to be used on the floor without fastening.

Heavy-Duty Truck Model Shock Absorber

Supplementing its well-known line of "Airplane-type" direct acting shock absorbers, the Monroe Auto Equipment Co., Monroe, Mich., has announced a heavy-duty truck model of "triple-action" type. This suit is quite com-



Monroe shock absorber

parable in design with the current shock absorber line, but is larger in size and capacity and features triple-action characteristics owing to the introduction of a lockout valve which affords secondary compression. The truck shock absorber is in production and is being installed in a large group of vehicles being built in the military truck program.

Two-Cycle, Air-Cooled Industrial Engines

A line of all-purpose, two-cycle, air-cooled, small industrial engines has been brought out by the Kiekhaefer Corporation, Cedarburg, Wis. Claims of greatly increased service life between inspection and repair periods are made. Spark plug life is said to be more than ten times that formerly an-

(Turn to page 80, please)

Forging today requires great preliminary enterprise, great machinery. Skill and long experience produce the dies set in the hammer face and on the anvil producing the tight, uniform grain structure, the highest known tensile strength plus toughness in metal. Skilled fast action controls the operation of forging hammers.

WYMAN-GORDON • Worcester, Massachusetts
 Harvey, Illinois Detroit, Michigan
FORGINGS—Laboratory Controlled

YOU will want to

See this Film...

the dramatic story of ALUMINUM

HERE is a 34-minute educational film on aluminum that is jam-packed with interesting information on its processing . . . from the mining of bauxite, refining it to alumina, reducing the oxide to metal . . . right on through to the rolling of sheet, rod and bar . . . and the manufacture of fabricated parts.

This film, titled "A Recital of Faith," portrays the great advances in aluminum technology during the war years, and the infinite possibilities for aluminum in the post-war world.

Underlined is the part Reynolds Metals is prepared to play in co-operation with engineers and manufacturers who are now using, or plan to use aluminum, and the new lightweight, high-strength aluminum alloys.

Showings easily arranged

Every audience that has seen "A Recital of Faith" has praised it in glowing terms. It is now available, without charge, for showings before technical groups, engineering societies and manufacturers . . . 35 mm. or 16 mm.

For full information, just write Reynolds Metals Company, Aluminum Division, 2503 South Third St., Louisville 1, Ky. On your letterhead, please.



REYNOLDS

The Great New
Source of

ALUMINUM

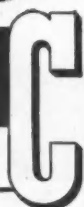
ROD • SHEET • SHAPES • WIRE • ROP • TUBING • FORGINGS • CASTINGS • PARTS • JOIL • POWERS

Continental

Molded, Extruded, Lathe Cut
RUBBER PRODUCTS

FOR A DOZEN,
a THOUSAND,
a **MILLION!**

• Manufacturers who design their products with Continental rubber parts know they are benefiting from the 42 years Continental has been serving American industry. Specialists in molded, extruded and lathe cut rubber products, Continental can be relied upon for correct production from the most suitable materials—natural or synthetic.



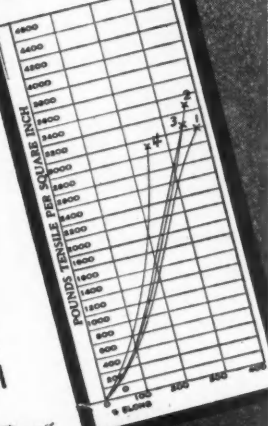
BRANCHES

Baltimore, Md.	Cleveland, Ohio	Greensboro, N. C.	Lutz, Fla.	Pittsburgh, Pa.
Boston, Mass.	Dallas, Texas	Hartford, Conn.	Memphis, Tenn.	Rochester, N. Y.
Buffalo, N. Y.	Dayton, Ohio	Indianapolis, Ind.	Milwaukee, Wis.	St. Louis, Mo.
Chicago, Ill.	Detroit, Mich.	Kansas City, Mo.	New York, N. Y.	San Francisco, Cal.
Cincinnati, Ohio	Evansville, Ind.	Los Angeles, Cal.	Philadelphia, Pa.	Syracuse, N. Y.

CONTINENTAL RUBBER WORKS
ERIE, PENNSYLVANIA, U. S. A.

LABORATORY REPORT

COMPOUND BN-80109E
MECH. 1-29-45 CURE TRAILER LOUIS
TESTED 1-30-45
TESTED BY COOK
DIE 1" X 1/4" ASBING
TEMP. 78°
FEMUR

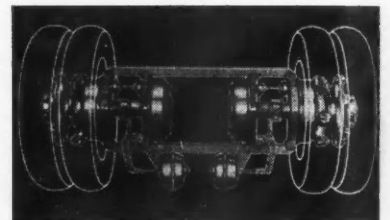


anticipated on small engines, and standard commercial spark plugs as well as aircraft plugs, can now be used on fuels, including 100 octane.

The Kiekhaefer Corporation's engines are distributed under the name of "Mercury," and all sizes are said to operate efficiently on leaded gasoline and detergent oil. A new ignition circuit, together with the special magneto, are the major contributing factors in perfecting the engine and providing for the use of modern fuels and oils. Other improvements include forged steel anti-friction connection rods, ball bearing crankshaft, and low piston speeds permitting upwards of 6000 hours of operation between piston and ring and other replacements.

Clark Announces Two New Automotive Products

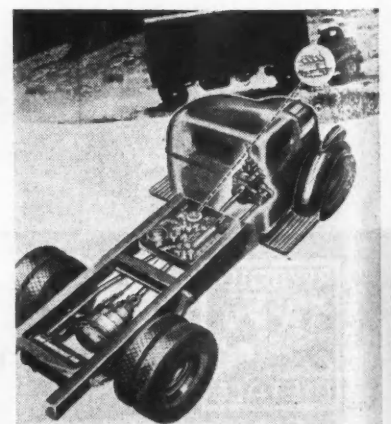
Ready for postwar promotion are two new products of Clark Equipment Co., Buchanan, Mich. They are the Clark Easy Roll trailer axle and the Clark Booster Unit for 1½-ton trucks.



Clark Easy Roll trailer axle

The Easy Roll trailer axle provides separate wheels for dual tires. By this means, each wheel rotates independently of the other, and has its own braking mechanism. The outer wheel is served by the inner brake, and the two are connected by an axle shaft through a heat treated hollow spindle on which the inner wheel is mounted. The inner wheel and brake drum are integral. This design, with its independently rotating wheels, provides a rectangular box construction of the load-carrying member. The four 16-in.

(Turn to page 82, please)



Clark booster unit

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6-in.

TRIES

THEY ARE SMALL... SELF-CONTAINED

COST VERY LITTLE

NEED NO SUBSEQUENT ATTENTION

EASY TO INSTALL

BUT 16 YEARS OF SERVICE PROVE

THEY PREVENT OIL LEAKAGE

EXCLUDE GRIT AND MOISTURE

REDUCE BEARING MAINTENANCE

KEEP THE BEARING IN GOOD OPERATING CONDITION

DESIGN THEM INTO YOUR POSTWAR PRODUCTS




Diagram showing arrows indicating the flow of the benefits: Downward arrows from the top, and upward arrows from the bottom towards the central seal image.

66 YEARS
MANUFACTURING QUALITY
LEATHER GOODS
EXCLUSIVELY
AND NOW
SIRVENE SYNTHETIC
PRODUCTS

CHICAGO RAWHIDE MANUFACTURING COMPANY
1310 ELSTON AVENUE • CHICAGO, ILLINOIS
Philadelphia • Cleveland • New York • Detroit • Boston • Pittsburgh • Cincinnati

IF YOU HAVE ANY QUESTIONS CONSULT CHICAGO RAWHIDE ENGINEERS

brake drums have a total braking surface of more than 400 sq. in.

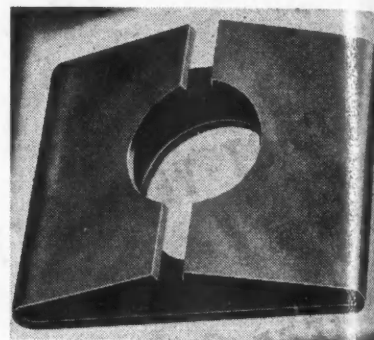
The Clark Booster Unit provides a reserve of power available when needed. It is mounted inside the vehicle frame just back of the cab—a compact unit that does not affect loading space. Cut in and cut out may be operated as desired. Power in-put is through the transmission. Its function is to provide high-year operation under conditions which normally require dropping back to low gear. According to performance data assembled by Clark, a conventional 1½-ton tractor hauling a fully loaded trailer can handle severest grades with a mini-

mum of gear shifting or none at all, thus having all the advantage of high gear operation.

Models have been built for Chevrolet and Ford trucks; and designs are completed for other makes of 1½-ton trucks.

Spring-Steel, One-Piece Push-On Fastener

A spring-steel, one-piece, push-on fastener for threadless studs of metal or plastic is now offered by Adel Precision Products Corp., Burbank, Cal. Called Stalock Push-On, the new fastener is a companion piece to the com-



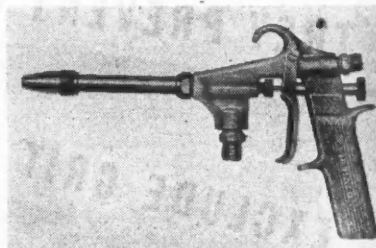
"Stalock Push-On" fastener

pany's recently announced line of Stalock Nuts.

Both are identified by an "all-around" locking engagement or grip to obtain maximum tightening efficiency. The new push-on fastener contacts almost the entire circumference of the stud. Furnished rust-proofed in standard sizes for studs or rivets with diameters of 3/32 in., 1/8 in., 5/32 in., 3/16 in. and 1/4 in. Special sizes will be made to order.

Gun for Industrial Degreasing and Cleaning

The DeVilbiss Company, Toledo, Ohio, is making a pressure feed spray gun especially designed for industrial degreasing and cleaning operations on castings, forgings, sheet metal, etc. Operated from a pressure feed tank,



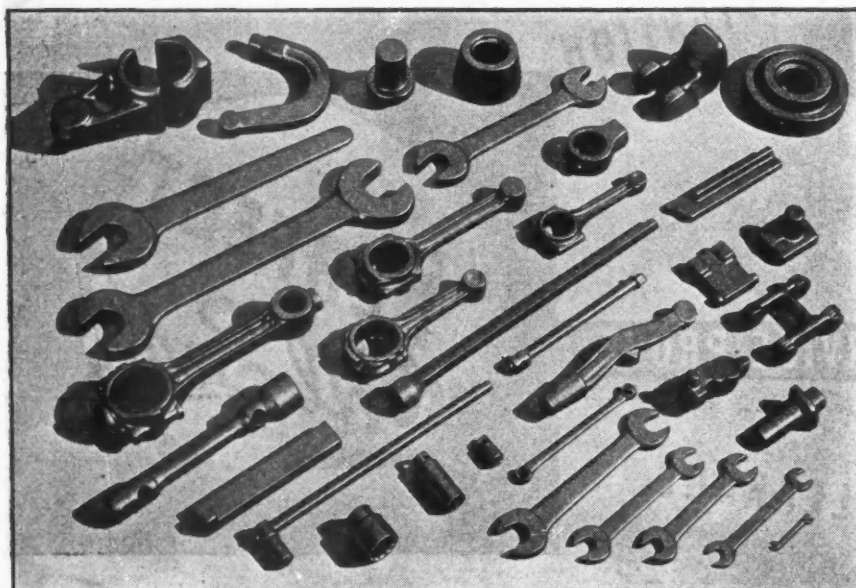
DeVilbiss degreasing spray gun Type GDZ

the gun handles all kinds of commercial solvents and cleaners, producing a heavy, driving, but well atomized spray that speedily removes dirt and grease. This new gun has a two-finger trigger designed to reduce hand fatigue. When the trigger is pulled only part way back, air alone is emitted from the nozzle, permitting the gun to be used for dusting and drying.

Machine for Sealing Flexible Plastic Packages

Recently the Sav-Way Industries, Detroit, Mich., announced a unique packaging machine for sealing flexible plastic packages. This machine, known as the Sav-Way Sara-Seal, automatically encases and hermetically seals suitable containers for any parts rang-

(Turn to page 85, please)



Herbrand PRECISION FORGINGS

Upset or Drop Forged--Any Shape or Size up to 200 lbs.

You who use forgings in war production work won't have a problem of faulty forgings if the job is being done by Herbrand. Our expert hammer-smiths, who have made forging their life business, maintain uniform dimensions and close tolerances producing forgings which are free from defects...Since our organ-

ization was founded in 1881, Herbrand has never lost sight of the importance of producing quality products conforming to exacting specifications.

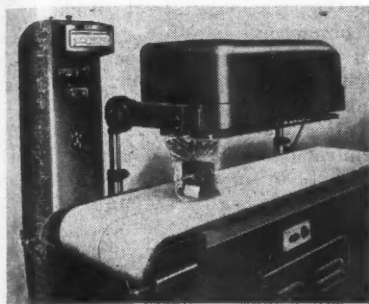
Today the counsel of the Herbrand engineering staff is available to help solve present war production problems, or for post-war planning... Your inquiries are solicited.



THE HERBRAND CORPORATION
FREMONT, OHIO

ing from tiny ball bearings to gyro-compass assembly.

Designed for handling Saran (Dow Chemical Co., flexible plastic sheet), the machine is being engineered for use with a wide range of the available flexible plastic materials. At the pres-



Sav-Way Sara-Seal machine

ent time the equipment is available only for the needs of the armed services; post-war it will play an important role in the packaging of parts for distribution in the automotive industry—as a protection on the shelves of jobbers and distributors, in service stations, and in the stock rooms of manufacturing plants.

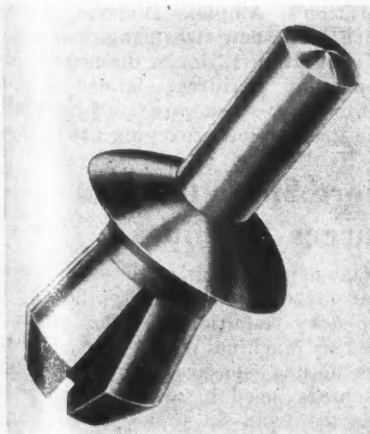
Plastic Blind Rivet

A plastic blind rivet permitting one-man operation and blind fastening is now in production at the Victory Manufacturing Company, South Pasadena, Cal. The design of the "Des-Rivet" is based on a wedging action and takes advantage of the flow characteristic of plastic materials under pressure.

"Des-Rivets" are molded as one piece consisting of a head with plug attached by a thin breakaway section and a tapered shank split to form four tapered fingers. The shank and head are hollow to the same diameter as the plug.

The "Des-Rivet" is applied by pressing the tapered fingers into a drilled hole. Taper on the outside diameter of the fingers reduces the inside diameter of the shank, the rivet and work being

(Turn to page 86, please)



"Des-Rivet" plastic blind fastening rivet

POSITIVE STEEL IDENTIFICATION*

For Quality Control

Provided with known samples, an operator with only a few hours training on the Identometer, can quickly sort most rolled or forged ferrous material to spot "wrong heat" stock for proper quality control.

Identometer with new Electronic timing control is the testing device that can quickly and accurately identify your materials. Positive quality control can be paced at speeds in keeping with modern shop tempo.

Read the whole story of this new metallurgical tool!—What it is and how it works is told in Bulletin 2D. Address—Dravo Corporation, National Department, 300 Penn Avenue, Pittsburgh 22, Pa.



new
electronic
model

DISTRIBUTED BY

DRAVO

* IDENTOMETER

AN ELECTRICAL INSTRUMENT FOR THE INSTANT AND ACCURATE IDENTIFICATION OF MOST ROLLED OR FORGED FERROUS ALLOYS BY THE USE OF REFERENCE SPECIMENS

held in place by the pressure of the depressed fingers. Impact from the rivet gun, which may be manual or air operated, shears the plug and drives it into the plastic shank until the plug is flush with both ends of the rivet, maintaining the contour of the rivet head. Complete installation is accomplished by this single operation.

U. S. Rubber Co. Develops New Synthetic Latex

A new synthetic rubber latex has been developed by United States Rubber Company at the Government's synthetic latex plant at Naugatuck, Conn.

The new latex is a modification of the butadiene-styrene type of synthetic rubber. Advantages of the new latex are greater uniformity and more easy handling and shipping. It mixes well with other ingredients and is therefore very easily compounded for uniform viscosity and other desired properties.

These advantages are said to give the new latex superior properties in saturating paper and fabrics for artificial leathers; in the backing of pile fabrics for upholstery; and in binding vegetable fibres and animal hair for the cushioning of combat tanks, parachute seats and backs, and upholstery. These properties also are of value in the solu-

tioning or dipping of tire cord with synthetic rubber latex.

Kolene Process of Surface Preparation

A combined cleaning and surface preparation has been developed by Kolene Corporation, Detroit, Mich., and is in commercial use for preparing cast iron surfaces, either machined or unmachined, for silver brazing operations.

This Kolene process of surface preparation is carried out by suspending parts in an open container of catalyzed molten salts through which an electrical current is passed. The surface impurities are removed by the formation of oxidation and reduction members in this Kolene bath, as desired. The surface to be silver brazed is then fluxed such as with A.M.S. 3410 and silver (soldered) brazed, as with A.M.S. 4770, in a conventional manner.

It has been found possible with this process to join steel stampings, tubing, pipe, etc., to cast iron fittings and parts.

Method for Making Electro Magnet Cores

A successful method of molding bakelite to provide sealed barriers between the coil windings and cores of its relays has recently been originated by the R-B-M Manufacturing Company, Division of Essex Wire Corporation, Logansport, Ind.

With this new technique, high impact bakelite is molded directly to electro magnet cores without deforming them in any way. As a result, the finished bobbin assemblies can be subjected to extreme limits of temperature without failure. The same method is also used to mold coil terminals directly in the bobbins, thus assuring adequate insulation and secure anchoring of the terminals.

Oilite Expands Cored And Bar Line

Several dozen new sizes of cored and solid bar stock in Oilite materials have been added to the line of Chrysler Corporation's Amplex Division, Detroit, Mich. The new sizes range from $\frac{3}{8}$ in. to more than 12 in. in diameter. Most important features claimed for the Oilite bar stock are self-lubrication and greater load carrying capacities.

More Space to Build Larger Machines

One of the effects of the trend toward ever larger aircraft is typified by the two-story addition to the plant of Onsrud Machine Works, Inc., Chicago. Onsrud has been producing spar milling machines, used in aircraft production, in sizes from 30 to 45 ft. in length. These machines are now required in lengths of from 75 to 105 ft. to match the growth in aircraft size.



The flange type bearing assemblies in MECHANICS Roller Bearing UNIVERSAL JOINTS can be lifted out simply by removing the two screw bolts that hold them in place. Let our engineers help you design and specify universal joint applications that will give your new and improved models this and several other advantages.



MECHANICS UNIVERSAL JOINT DIVISION

Borg-Warner Corporation

2020 Harrison Avenue, Rockford, Ill. Detroit Office, 7-234 G. M. Bldg.

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JAMES SESSIONS paints his impression of Borg-Warner's Ingersoll plant at Kalamazoo. Here, where furnaces are made in peacetime, Borg-Warner-designed amphibian "Beachbusters" are now built by mass production methods.

*Almost every American
benefits every day
from the products of*
BORG-WARNER

*Partners with the automotive
and aviation industries in peace
and war, Borg-Warner supplies
these and other essential parts...*

CLUTCHES AND CLUTCH PARTS • GEARS
UNIVERSAL JOINTS AND DRIVE SHAFTS
TRANSMISSIONS • TIMING CHAINS
CARBURETORS • RADIATORS
PUMPS • AVIATION STEEL

ENGINEERING

BW

PRODUCTION

The appliances that make your home more livable . . . the automobile, airplane or boat that transports you . . . the food you eat . . . all bring Borg-Warner into your life.

For, in peacetime, this company makes a truly astounding variety of essential products. And no matter what the product, Borg-Warner engineers are guided by this one basic principle:

"design it better—make it better."

Perhaps this explains why Borg-Warner has, for years, been privileged to work with other industries in developing ever better products at ever lower cost.

When America's production genius need no longer be concentrated on war needs, Borg-Warner will again work hand in hand with your industry in turning out the products of peace.

Peacetime makers of essential operating parts for the automotive, aviation, marine and farm implement industries, and of Norge home appliances . . . these units which form the Borg-Warner Corporation are today devoted exclusively to the needs of war: BORG & BECK • BORG-WARNER INTERNATIONAL • BORG WARNER SERVICE PARTS • B-W SUPERCHARGERS, INC. • CALUMET STEEL • DETROIT GEAR AIRCRAFT PARTS • DETROIT VAPOR STOVE • INGERSOLL STEEL & DISC • LONG • MARBON • MARVEL-SCHLEBLER CARBURETOR • MECHANICS UNIVERSAL JOINT • MORSE CHAIN • NORGE • NORGE MACHINE PRODUCTS • PESCO PRODUCTS • ROCKFORD CLUTCH • SPRING DIVISION • WARNER AUTOMOTIVE PARTS • WARNER GEAR



for Production Measurement of Shell Surfaces

PRCo announces its Type CP Roughness Meter for the roughness measurement of the surfaces of high-explosive shells. The Roughness Meter enables the control of the surface roughness of shells on a practical production basis in much the same manner as the Profilometer for checking surface roughness of precision machine parts.

In appearance and operation, the Roughness Meter greatly resembles the Profilometer except that it enables the measurement of surface irregularities so widely spaced as to be beyond the range of the Profilometer, now generally used on smoother surfaces. The Roughness Meter employs a hand-operated Tracer which traces the surface of the shell, and gives a reading on the meter directly in terms of microinches of average roughness.

To withstand the heavy use of the equipment on shell inspection lines and on the extremely coarse surface found on shells, the Tracer used with this unit is heavy and rugged and uses a blunter, stronger tracing point than that with the Profilometer. The Tracer can be used by hand to measure from the tip of the ogive to the boattail, the Tracer point being self-adjusting to changes of curvature of from $1\frac{1}{2}$ " OD to flat.

Because of the importance of surface roughness in the performance of shells and, therefore, in the efficiency and accuracy of our artillery, Physicists Research Company is making every effort to give prompt delivery for this equipment. If your plant is faced with the problem of controlling the surface roughness of high-explosive shells, we will be pleased to have our representative call and discuss the matter in more detail with you. Complete information on the Type CP Roughness Meter will be gladly supplied on request.

Physicists Research Company

343 SOUTH MAIN STREET · ANN ARBOR · MICHIGAN

Production of Silver

(Continued from page 42)

from a simultaneous increase of orders for heavier aircraft and for the floating bridge program. The latter will require 40,000,000 pounds of extrusions to be delivered by September, with something over 35,000,000 pounds having to be delivered before July 1. The release ends with this significant statement: "Manpower alone is the determining factor. A total need of 9,000 new workers is indicated."

Again more or less seriously interrupting the flow of steel scrap to primary mills is an aversion to the handling of alloy steels, which dealers claim to be the source of heavy losses to them.

Business in Brief

Written by the Guaranty Trust Co.,
New York, Exclusively for AUTO-
MOTIVE AND AVIATION INDUSTRIES

Relatively steady levels of business activity are indicated. The New York Times index for the week ended Jan. 20 stands unchanged at 147.2, as against 140.6 a year ago.

Department store sales, as reported by the Federal Reserve Board, declined from 166 to 160 per cent of the 1935-39 average during the week ended Jan. 20.

Railway freight loadings in the same period totaled 777,320 cars, 0.6 per cent below the figure for the week before and 2.7 per cent less than the number reported a year ago.

Electric power production during the week ended Jan. 27 was slightly reduced but remained 1.2 per cent above the corresponding level in 1944.

Crude oil production in the same period averaged 4,727,150 barrels daily, 6600 barrels below the figure for the preceding week but 2450 barrels more than the output recommended by the Petroleum Administration for War.

Production of soft coal during the week ended Jan. 20 is estimated at 11,960,000 net tons, 1.6 per cent below the output in the week before and 5.4 per cent less than the corresponding amount last year.

Engineering construction contracts awarded during January, according to Engineering News-Record, totaled \$88,193,000, the lowest monthly amount reported since 1935 and the smallest January total since 1922. Awards for private construction, however, were 110 per cent above the figure for the preceding month and 33 per cent more than the corresponding sum in 1944. Contracts for public work registered comparable recessions of 28 and 58 per cent, respectively.

The Irving Fisher index of wholesale commodity prices on Jan. 26 stood at an all-time peak, 114.32 per cent of the 1926 average, as against 114.15 a week earlier and 112.47 a year ago.

Member bank reserve balances declined \$71,000,000 during the week ended Jan. 24, and excess reserves were reduced by \$100,000,000 to an estimated total of \$1,200,000,000. Aggregate loans and investments of reporting members declined \$15,000,000 in the same period, with commercial, industrial and agricultural loans showing a drop of \$38,000,000, to a total of \$6,377,000,000.

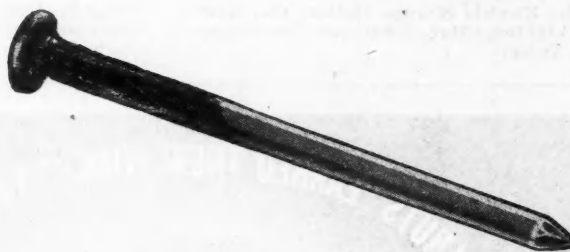
What to do about Rust?

*Make
this Test*



Immerse any rusty nail in a small quantity of Cities Service Rust Remover. If badly rusted, allow to remain for several minutes. You can actually see the rust dissolve.

See the Results



Remove nail and wipe dry with cloth or tissue. Note the complete absence of rust and the way the original surface reappears.

CITIES SERVICE RUST REMOVER has been tested for four years throughout a small, highly industrialized area in the East, where it has earned a unique reputation for performance. **RUST REMOVER** is a clean, clear liquid, practically odorless, non-inflammable, easily applied,

and harmless to handle by those not allergic to specific chemicals. It is fast-acting, and, although heating somewhat accelerates results, general application is recommended at normal temperature (60°-90°F). **RUST REMOVER** is effective on chromium, copper, aluminum, steel and iron.

5 Big Advantages

1. Non-Inflammable
2. Harmless to Normal Skin
3. Makes Metals Chemically Clean
4. Removes Rust by Chemical Action
5. Free from Muriatic, Sulphuric, Nitric and Oxalic Acids or Cyanide.



See a Free Demonstration of Rust Remover on Your Own Equipment.

(Available only in Cities Service marketing territory East of the Rockies.)

MAIL THIS COUPON TODAY!

CITIES SERVICE OIL COMPANY

Room 186
Sixty Wall Tower, New York 5, New York

Gentlemen: I'd like to test **RUST REMOVER** on my own equipment **FREE OF CHARGE**. Send me details.

Name.....

Company.....

Address.....

City..... State.....



CITIES SERVICE OIL COMPANY
NEW YORK • CHICAGO

ARKANSAS FUEL OIL COMPANY
SHREVEPORT, LA.

PERSONALS

Recent Appointments Among Automotive and Aviation Manufacturers:

Consolidated Vultee Aircraft Corp., K. F. Leaman, Works Mgr., Elizabeth City, N. C., Div. G. F. Gerhauser, Chief Tool Engineer, San Diego Div.

The Timken Roller Bearing Co., Everett C. Hite, Combustion and Refractories Engineer, Steel Mill Metallurgical Dept.; John J. Yezbak, Mgr. of Public Relations and News Bureau.

Lockheed Aircraft Corp., J. C. Towle, Chief Pilot.

The Electric Storage Battery Co., Lester E. Lighton, Mgr. Dept. of Development and Design.

The Sparks-Withington Co., Edward C. Bonia, General Sales Mgr., Radio and Appliance Div.

Chrysler Corp., Export Div., L. H. Perry, General Works Mgr.

Mack-International Motor Truck Corp., Willard Walker, Vice-Pres., Mgr. of Greater New York Div.

Pennsylvania Rubber Co., Gordon H. Groth and R. B. Cave, Vice-Presidents.

Kellett Aircraft Corp., William L. Wilson, Vice-President.

Chrysler Corp., V. E. Blue, Director of Personnel.

Timken-Detroit Axle Co., Paul V. Osborn, Factory Mgr. of Detroit operations; V. E. Gumbleton, Director of Purchases and J. L. Griffin, Purchasing Agent for company's Detroit axle plants.

Graham-Paige Motors Corp., R. E. Stone, Vice-President and Secretary.

General Motors Corp., Norman K. Haig,

Mgr. War Products Training Service, succeeding John E. Johnson, now head of Public Relations Office.

Harry Ferguson, Inc., Harry D. Myers, Director of Procurement.

Curtiss-Wright Corp., Frederick W. Moore, General Production Mgr., Propeller Div., Caldwell, N. J.; J. R. Eggert, Plant Mgr. at Caldwell and Clifton, N. J., and George L. Lang, Plant Mgr. propeller plant at Indianapolis.

Stewart-Warner Corp., Norman J. Cooper, Service Mgr., Electrical Products Div.

Pesco Products Div. of Borg-Warner, A. E. Wilson, Ass't. Sales Mgr. for Automotive Div.; E. S. Moreland, General Sales Mgr.; Ray G. Holt, Field Representative for Sales Dept.

Simmonds Aerecessories, Inc., Howard Holmes, Sales Mgr. and Russell Newcomb, Sales Promotion and Adv. Mgr.

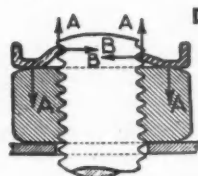
Perfect Circle Co., Industrial Relations Div., Irving Lacy, Ass't. to Director; Frank Trittschuh, Supervisor of Credit Union and Group Insurance Programs; Ted Green, Wage Administration Mgr.; Kent Morse and Allen Smith, Job Analyst and Ass't Job Analyst, respectively.



HOLD TIGHT UNDER SEVEREST VIBRATION!

Double Locking PALNUTS are no "war babies." They have been standard on Army, Navy and Commercial aircraft engines for more than 15 years and are also used on accessories of all kinds. They have proved their unflinching double-locking action under every flying condition.

PALNUTS are single thread, tempered spring steel locknuts—easily, quickly applied on top of regular nuts. They require only 3 bolt threads space, providing great holding power with little bulk or weight. PALNUTS are low in cost, may be re-used, withstand high temperatures and are interchangeable with other approved locking devices.



DOUBLE LOCKING ACTION

When the PALNUT is tightened, its arched, slotted jaws grip the bolt like a chuck (B-B), while spring tension is exerted upward on the bolt thread and downward on the regular nut (A-A), securely locking both.

THE PALNUT COMPANY
60 Cordier St. Irvington 11, N. J.

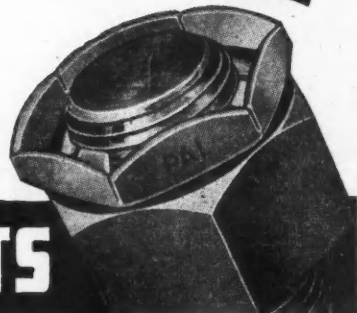
**DOUBLE-
LOCKING**

PALNUTS

—USED ON—

Engines • Propeller Controls
Engine Oil Coolers • Auxiliary
Power Plants • Superchargers
Governors • Carburetors
Cockpit Lamps • Filters • Limit
Switches • Electric Motors
Fire Extinguishing Systems
Plastic Window Assemblies

WRITE for samples and copy of Palnut Manual No. 1 which gives details on advantages, uses, application, sizes, etc.



Pay Increase Asked For Salaried Employees

National Steel Corp. has applied to the National War Labor Board and the Treasury Department for authority to increase the compensation of all salaried employees by approximately five per cent, the increase to be retroactive to Dec., 1943. The application covers all salaried employees of National Steel Corp., Great Lakes Steel Corp., Wierston Steel Co., and the Hanna Furnace Corp., according to E. T. Weir, board chairman.

Barber-Colman Appoints West Coast Distributor

The Barber-Colman Company, Rockford, Ill., announces the appointment of the Garrett Supply Co., Los Angeles, Cal., as distributors for Barber-Colman hobs, milling cutters and reamers. Barber-Colman Company has also opened a divisional machine tool engineering and sales office in Los Angeles. This office is under the supervision of Roy H. Jones, who has been associated with Barber-Colman for over 27 years.

CALENDAR

Conventions and Meetings

Motor & Equipment Wholesalers Assoc.	Feb. 26-28
Annual Meeting, Chicago	
Amer. Soc. for Testing Materials, Pittsburgh	Feb. 28
SAE Aeronautic Meeting, New York	April 4-6
Midwest Power Conf., Chicago	April 9-10
SAE Transportation and Maintenance Meeting, Pittsburgh	May 2-3
Pan - American Aircraft Exposition, Dallas, Texas	May 20-27
SAE War Materiel Meeting, Detroit	June 4-6
American Society for Testing Materials, Annual Meeting, Buffalo	June 18-22
SAE Tractor Meeting, Milwaukee	Sept. 12-13

"LUCITE"

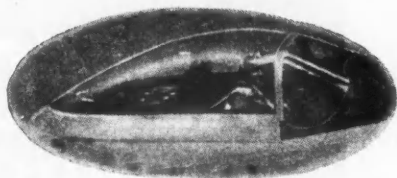
COCKPIT CANOPIES OF

INCREASE VISIBILITY IN P-51 MUSTANG 75%

OLD WAY



NEW WAY



Advantages: Replaces old-style hood made of eight transparent panels, held together by metal ribs. Eliminates blind spots, permits full vision in all directions in all flying positions. Reduces canopy production time 45% in man-hours. Slides back and forth for easy entrance and exit of pilot. Makes radio equipment accessible instantly.

Canopy formed by Swedlow Aeroplastics Corp., Glendale, Calif., for North American Aviation, Inc., Inglewood, Calif.

P-51 Mustang pilots now fly under a protective canopy of transparent Du Pont "Lucite" methyl methacrylate resin. Because of its ability to be heated and formed into streamlined contours, this one-piece enclosure can be shaped by a new vacuum method in less time than was formerly required to produce the old-style canopy. This technique also reduces optical distortion during forming. In addition, the plastic "teardrop" reduces riveting operations and operations on alloy sheet stock as well as eliminating the use of machined parts.

"Lucite" possesses remarkable transparency, light weight, tensile strength and is outstanding among plastics for its weather resistance. WPB-allocated, experimental quantities can be obtained for your test purposes.

Address: E. I. du Pont de Nemours & Co., Inc., Plastics Department, Arlington, N. J., or 5801 South Broadway, Los Angeles 3, Calif. In Canada: Canadian Industries, Ltd., Box 10, Montreal.

DU PONT PLASTICS

BETTER THINGS FOR BETTER LIVING
... THROUGH CHEMISTRY



Screw Machine Products

U.S. AUTOMATIC
CORPORATION
AMHERST ★ OHIO



Chicago Detroit New York

General Data on the Valiant Basic Trainer

General Type	Basic Training Air- plane
U. S. Army Designa- tion	BT-13 or BT-15
U. S. Navy Designa- tion	SNV-1 or SNV-2
Army Designation of Engine	R-985-AN-1 or AN-3
Horsepower Rating	450 (2300 rpm)
Critical altitude	Sea Level
Gear Ratio	Direct Drive
Maximum Horsepower for Take-off	450 (2300 rpm for 5 min.)
Maximum Speed at Sea Level	164 mph
Operating Speed at Sea Level	140 mph
Endurance at Operat- ing Speed	4 hours
Service Ceiling	16,500 ft
Time to Climb to 10,000 ft.	13 min.
Take-off Distance to Clear 50-ft Obstacle	1,175 ft (with flaps)
Landing Distance over a 50-ft. Obstacle....	1,125 ft (with flaps)
Gross Weight	4,498 lb

Group Weight Statement (All weights in Lb)

Wing Group:		
Center Section	416.5	
Outer Panel	220	
Tips	24	
Ailerons	58	
Flaps	50	
Cover Strips	4.5	
Total	773	
Tail Group:		
Stabilizer (with brace tubes, etc.)..	68	
Elevator	30	
Fin (with attaching parts).....	21.5	
Rudder	19	
Fairing and Install. Parts.....	4.5	
Total	147	
Body Group:		
Fuselage	489	
Accessories	8	
Total	497	
Landing Gear:		
Main Landing Gear	250	
Auxiliary Landing Gear (Tail Wheel)	35	
Total	285	
Engine Section or Nacelle Group.....		135
Power Plant Group:		
Engine (as installed)	676	
Engine Accessories	65	
Power Plant Controls	20	
Propellers	163.5	
Starting System	44.5	
Lubricating System	51	
Fuel System	28	
Total	1048	
Fixed Equipment Group:		
Instruments	76	
Surface Controls	118	
Electrical System	166	
Communicating and Marker Beacon	120	
Furnishings	100	
Total Weight Empty	3465	

Unit Weights

Wing Group (Gross Area, 239 sq ft)	3.23 psf
Tail Group (Gross Area, 62.17 sq ft)	2.36 psf
Weight of Lubricating System per gal oil:	
Capacity (10.9 gal. of oil).....	4.68
Weight of Fuel System per gal capacity:	
(120 gal. of Fuel).....	0.23

Useful Load Weights

Crew of Two	400
Engine Fuel (92 gal)	552
Fuel Trapped in System (1 gal)	6
Engine Oil (8.5 gallons).....	63
Oil trapped in system (1.6 gal).....	12
Total	1033

**A 2-POINT SERVICE
FOR YOUR POST-WAR
HYDRAULIC NEEDS**



by **ADECO**
**SPECIALISTS
IN
HYDRAULICS**

In lining up your post-war schedules, it will pay you to utilize Adeco experience and facilities. These specialists in hydraulics can help you in two important ways:

- 1 Assist you in designing hydraulic mechanisms to meet your*requirements.
- 2 Work with you in producing precision parts and assemblies on a contract basis.

An illustrated booklet presents the story behind this Adeco service. Write for your copy today.



**AIRCRAFT AND DIESEL
EQUIPMENT CORP.**

4401 NORTH RAVENSWOOD AVENUE

CHICAGO 40, ILL.

YOUR PARTNERS IN PRECISION



HAYES
AIRCRAFT
Wheels and Brakes

SAVING POUNDS FOR MORE PAY-LOAD

Weight-saving is an operating advantage engineered into Hayes Expander Tube Brakes. Airlines translate this into added pay load availability amounting to hundreds and thousands of dollars annually, dependent on the load factors involved.

This revenue producing characteristic—combined with low cost per landing, ease of maintenance and rugged reliability are *service-proved* factors on such airlines as Eastern, Penn-Central, United and Western — where Hayes Expander Tube Brakes are standard equipment.



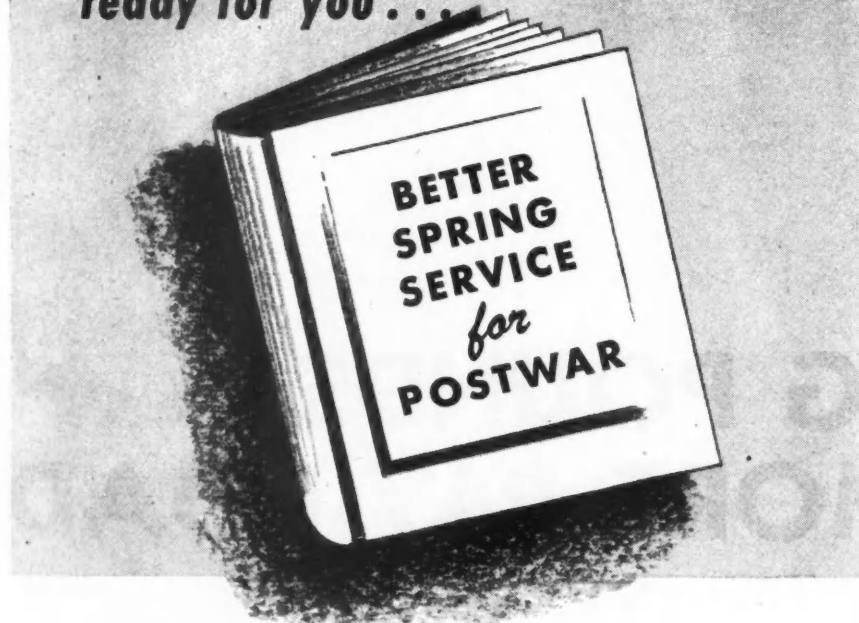
All U. S. 4-Engine Bombers,
including
BOEING B-17 and B-29
CONSOLIDATED B-24
are equipped with
HAYES WHEELS and
EXPANDER TUBE BRAKES

Western Representative: Airsupply Co., 5959 W. 3rd St., Los Angeles 36, Calif.

HAYES INDUSTRIES, INC.

Home Office: JACKSON, MICHIGAN, U. S. A.

**Accurate has a volume of experience
ready for you . . .**



WE haven't put it in a book—but the new experience we've acquired in these war production years would probably fill one. This new knowledge added to past know-how will be ready to give you an even better Accurate service on all types of precision springs and wireforms. Carefully controlled manufacture, modern equipment, skilled personnel, broad experience . . . plus engineering that has managed to find better, faster, economical ways of producing both intricate and ordinary jobs . . . These are the advantages that Accurate offers as a source of supply for the springs you will need in the postwar era.

SPRINGS
WIREFORMS
STAMPINGS



Send for your copy of
the new *Accurate
Spring Handbook*.
It's full of data and
formulae which you
will find useful. No
obligation, of course.

ACCURATE SPRING MANUFACTURING CO.

3811 West Lake Street, Chicago 24, Illinois

Detroit's Greatest Production Year

(Continued from page 42)

how prevalent these practices are. Union leaders say they are isolated cases, and point to the great production now being achieved with fewer workers than ever before. What they fail to recognize is that production techniques have been improved so that output should step up with fewer workers and, more important still, that it is not what has been achieved but how much more could have been done if all workers had given all-out effort. This question of individual worker efficiency now is assuming a paramount place in war industry, especially in the automobile segment, since it will have an important bearing on postwar operations. Henry Ford II, executive vice president of Ford Motor Co., put it neatly in a recent address when he said that it is not what a man is paid per day that is important, but the amount of work he does for what he is paid. One man paid \$50 a day might be more profitable than one paid \$1 a day on the basis of individual output.

Whatever may be the outcome of the present wrangling over labor supply, use, efficiency, or hoarding of labor, it is certain that new war work will continue to flow into the plants of the producing centers until the end of the war with Germany. What will happen after that, no one in government apparently knows or is willing to say. One official of a government agency said privately that if Germany should fall soon, war work probably would continue without a break for a while until needs for the Japanese war could be determined and machinery set up for reconversion.

A brief view of some of the major war production programs shows the following: *Heavy artillery ammunition* (over 105 mm)—Present schedules call for output of \$80 million a month in March and upward of \$100 million later in the year. *Aircraft*—Major emphasis will be on B-29 bomber, C-54 cargo ship, and B-17 and B-24 bombers. Navy

(Turn to page 96, please)

FOR

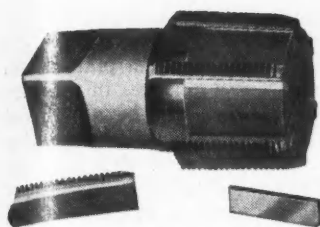
**CLEAR,
SHARP MARKING**

USE..

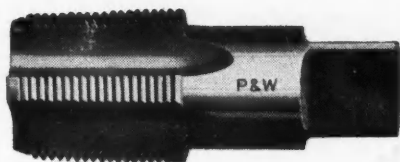
W. E. MUNNINGS CO.

SAFETY STEEL STAMPS

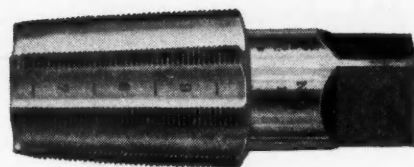
220 E. CARSON ST., PITTSBURGH, PA.



Inserted Chaser Taper Pipe Tap



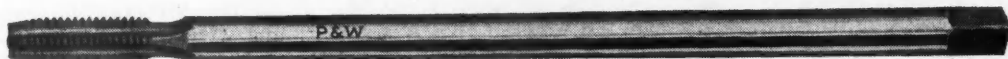
Taper Pipe Tap



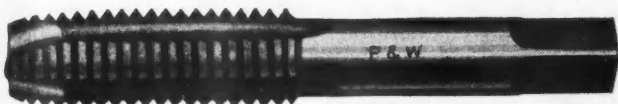
Mud or Washout Tap



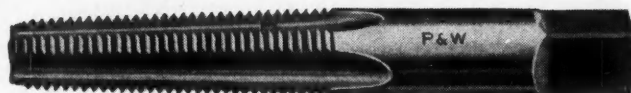
Staybolt Tap



Pulley Tap



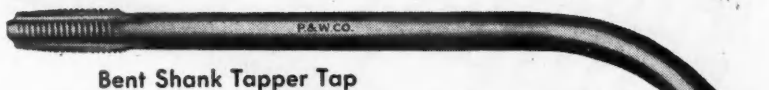
Spiral Pointed Hand Tap



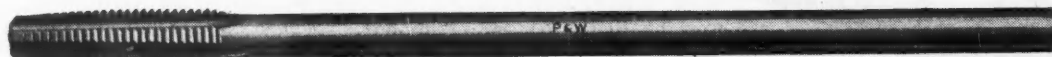
Taper Boiler Tap



Hook Tap



Bent Shank Tapper Tap



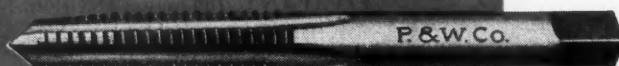
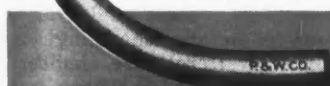
Straight Shank Tapper Tap



Spiral Pointed Machine Screw Tap

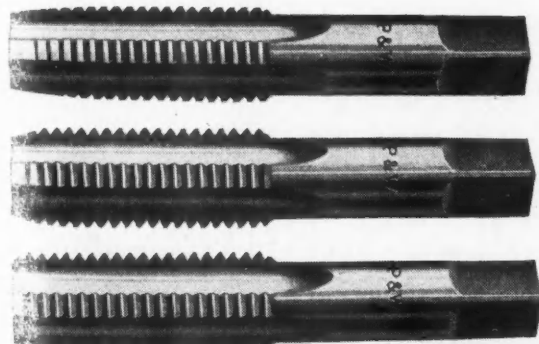


Standard Machine Screw Tap



Standard Hand Tap

A COMPLETE SERVICE ON TAPS



Standard Hand Taps



Pratt & Whitney taps include all kinds . . . the right one for any tapping operation regardless of material or the desired accuracy. Each one is a combination of proper design, top quality steel, scientific heat treatment and fine craftsmanship. For lowest cost per tapped hole . . . for trouble-free production . . . specify P&W taps.

Illustrations show a few of P&W's wide variety of taps. Ask for complete listings of sizes and prices.

PRATT & WHITNEY

Division Niles-Bement-Pond Company

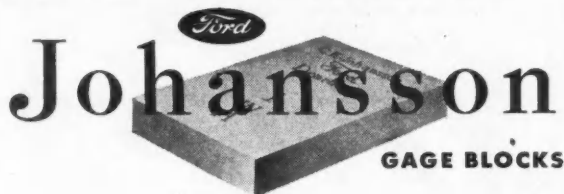
WEST HARTFORD 1 • CONNECTICUT

Your best man
is a better man with
JO-BLOCKS back of him



Certainly, a good mechanic will "feel his way" through a job with all the accuracy it calls for. But he'll do it faster, with more sureness, more pride in the result and less worry over possible errors if he's got JO-BLOCKS to work with. The super-accuracy of Johansson Gage Blocks (to .000004 or .000008) is positive insurance that your coarser tolerances of thousandths or "tenths" can be maintained. And JO-BLOCKS

are working tools, too, for laying-out, locating, scribing, checking work, as well as checking gages and mikes. Popular No. 1 Set of 81 pieces makes 120,000 different size gages in steps of .0001, from .200 of an inch to more than 12 inches. Deliveries now within 30 days. Write for catalog. Address: FORD MOTOR COMPANY, Johansson Division, Dept. AA, Dearborn, Michigan.



fighters and jet-propelled planes also will be hot. Design changes in the B-24 are under way and will be announced soon. Engines and parts for replacements also will be critical. *Heavy-heavy trucks*—Production today is higher per month than per year in peace time, but still more are needed. Castings are still a bottleneck and heavy-duty axles are critical. More than 20,000 suppliers are involved. *Tanks*—Requirements now are up to nearly 2000 a month from the production level of 1200 monthly early last year. They now are on the critical list because of basic design changes including greater fire power, mobility, and wider treads. Production is under way at Chrysler and Fisher arsenals on a new tank of heavy design.

The tentative schedule for the 1945 overall truck program (civilian and military) is much more realistic than the one proposed a year ago for 1944. This year's goal has been set at 869,212 trucks of all types, as compared with the 1944 original schedule of more than 1 million. This schedule subsequently was revised downward several times in the light of production possibilities finally ending up at 805,506. Actually, final production figures showed that 743,750 trucks (excluding half-tracks and armored cars) were produced in 1944. With the allocation of 245,449 trucks for essential civilian use this year announced recently by WPB, 623,763 trucks would be for military use under the announced 1945 production program.

Hopes of the automobile industry and others of obtaining machine tools needed for reconversion have been dashed by a WPB amendment requiring machine tool builders to meet all deliveries on rated orders before scheduling any unrated orders. Heretofore, builders have been allowed to devote 25 per cent of their production to rated and non-rated non-military orders. Under the new amendment, they may not schedule any unrated orders for delivery unless they do not have enough rated orders to take all of their output. However, any unrated orders scheduled before January 26 for delivery before April 1

(Turn to page 98, please)

... for those **TOUGH** drawing jobs—

The performance of SuperKool in accomplishing impossible draws has made friends for it in plants producing all types of metal products from kitchenware to bombs. SuperKool spreads smoothly, adheres well, and holds up under highest pressures. Stuart Oil Engineers are qualified by long experience to help you with your metal working problems. D. A. Stuart Oil Company, Limited, 2733 So. Troy Street, Chicago 23, Illinois.

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FOR ALL CUTTING FLUID PROBLEMS
Stocks in All Principal Metal
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AND DETWISTING MACHINE

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Standard Units
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may be filled, except for any changes in schedules required by a diversion or by a specific direction of WPB.

Pontiac Motor Div. of General Motors Corp. has moved machinery into its rocket plant in preparation for production of five-inch, high velocity assault rockets for the navy as soon as the contract is signed. Pontiac will produce the entire rocket with the exception of the nose fuse and explosive charge. Size of the contract was not announced, other than it would amount to "many tons."

Graham-Paige Postwar Selling Plans Announced

Joseph W. Frazer, chairman of Graham-Paige Motors Corporation, announced recently that plans for the marketing of the company's postwar automobile have reached the final stage and that awarding of franchises to a nationwide network of 1,200 distributors probably will begin within the next 90 days.

Discussing his company's postwar plans at a meeting of the New York Society of Security Analysts, Mr. Frazer said that his company would operate exactly the opposite of many automobile concerns which have been selling direct to dealers.

"Our method of distribution will differ from that of many other automobile companies," he explained, "in that dealers will function under distributors in territory allotted to them. We anticipate a dealer body of 3,500 to 4,000 and the distributors will make these appointments as cars become available and volume increases."

Advertising Note

Several changes have been made in the advertising department of The Perfect Circle Company. Robert Bland has been named assistant advertising manager, taking the place vacated by Martin Davis. Mr. Bland has been supervisor of advertising production for many years. Archie Hindman fills the position vacated by Robert Bland.

FELT

Only first rate FELTS, meeting required specifications and tests, will function properly. Substitutes will not do. Check this with your engineers . . . then buy FELT with confidence.

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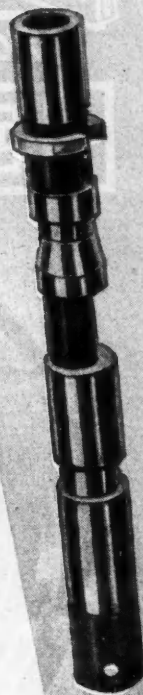
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to a tolerance of $\pm .0001$ of an
inch. Available in .001 oversize
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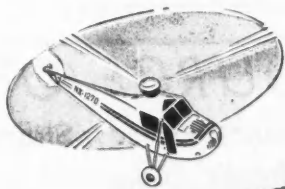
"I TOLD You!" -it's a Job for Aeronautical Products, Inc."



WHEN your machining specifications say "Tolerance .0005," to us it means five ten-thousandths of an inch, and not a whisper more, or less. Tolerances like these, and much finer, call for experience, skill and machinery of vast proportion. So, if YOUR post-war assemblies require precision machining in volume, right from engineering through to the final inspection, it's a job for Aeronautical Products, Inc.! Here in one complete organization is everything your job needs. Controlled responsibility . . . no buck-passing. You get your answers straight from the shoulder and backed with performance. If our set-up sounds good to YOU, ask your secretary to write our Executive Sales Offices, Detroit, for an impressive list of plant equipment and complete facilities.

● THE SUCCESS of The Aeronautical Products, Inc. Helicopter, designed and built by our own craftsmen, promises new accomplishments in the post-war age of flight!

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MORE
BONDS
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Forty Years of Proved
DEPENDABILITY!



*For
 THAT VITAL SPOT
 where
 POWER TAKES HOLD
 OF THE LOAD!*

BORG & BECK

The Standard Clutch in Peace or War!



BORG & BECK DIVISION

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CHICAGO, ILLINOIS

BOOKS . . .

THE WORLD'S AUTOMOBILES, by G. R. Doyle, 22 Windmill Hill, Middlessex, England, is a most far-reaching and comprehensive report on the different makes of motor cars since the early days. The original (1932) edition is revised and extended, and embodies a war-time supplement with 797 further entries and about 200 new footnotes. Included are particulars of nearly 3000 makes of cars, including country of origin, system of propulsion, makers name and factory address, and dates of manufacture. As a book of reference it is most valuable, as the author has put on record the names of the makers who have helped in the building of this great industry, with its remarkable ups and downs.

The list is international in character, and each car is entered under the name by which it is known in the country of its origin. All of the cars listed have actually been on the market and in the case of the American cars, the author has omitted a number of makes with a life of under two years.

Price, \$2.50, remittable by international money order, American Express draft or check on London.

Rockford Drilling Machine Division Changes Name

The name of Rockford Drilling Machine Div. of Borg-Warner Corp., Rockford, Ill., has been changed to Rockford Clutch Division. The division has acquired the Borg-Warner research laboratory at Rockford and will operate it as the Rockford Clutch Engineering Laboratory.

Rockford Drilling Machine Co., has been a division of Borg-Warner since 1929 and is the outgrowth of a company incorporated on Oct. 24, 1899. For months after Pearl Harbor it was the sole supplier of medium tank clutches for the U. S. Army. At present, the division also is building clutches for the U. S. Navy.

Purolator Moves Offices

The executive and general offices of Purolator Products, Inc., have been moved from the company's plants to the National Newark Building, 744 Broad St., Newark, N. J.



ALWAYS A SOURCE OF SUPPLY

For Machine Tools, Stamping Presses, Structural Machinery,
 Forging Equipment, Hydraulic Equipment, Air Compressors,
 Production Equipment.

OUR SERVICES ARE ALWAYS AT YOUR DISPOSAL

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SLEEVE TYPE BEARINGS for Every Type of Industry

For the New Product

One sure way to make a sales leader out of your new product is to build real performance into it. The best way of securing performance is to select the *correct* bearing for each application. The easiest way to select the right bearing is to consult with Johnson Bronze.

We are particularly well fitted to assist you. As we manufacture all types of sleeve bearings . . . cast bronze . . . babbitt lined . . . sheet metal . . . powdered bronze, we hold no prejudice for any one kind. All of our experience, our facilities and our research for more than thirty-five years have been devoted to producing better bearings.

Why not call in a Johnson Engineer now? Permit him to review your applications . . . to make recommendations based on your operating requirements. There is one located near you. There is no obligation.

For Maintenance

The operating schedules of practically all machines during the past five years have been terrific . . . without parallel in our industrial history. Yet most manufacturers believe that the schedules for the postwar period will be even greater. How is your equipment going to meet this demand?

The first thing to check is the bearings. No doubt a good many will have to be replaced. When replacement is necessary—specify Johnson Bronze. We offer you the most complete line on the market . . . over 350 sizes of UNIVERSAL Bronze Bars . . . over 800 sizes of plain cast bronze bearings . . . 250 types of Electric Motor Bearings . . . babbitt and Ledaloyl, self-lubricating bearings. Every item in the line is the highest quality possible.

Call your local Johnson Bronze Distributor or write for Catalogue No. 410.

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COMES FIRST

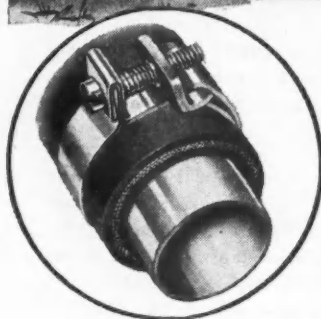
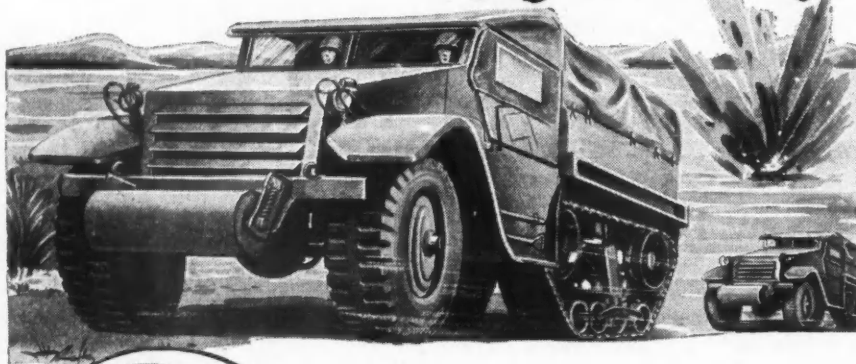
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Action!



•Army and Navy combat vehicles, farm and road-building machinery, diesel and gasoline engines, and all types of radiator hose are equipped and serviced with Central Universal Hose Clamps.

**SEND TODAY FOR
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When requesting sample
please specify "Universal".

THE *Half Track* DEPENDS ON CENTRAL CLAMP-POWER

Central Universal Hose Clamps are supplying vital clamp-power with unfailing dependability to America's war machine.

They are strong enough for every production and service requirement . . . precision built of rustproof, extra-heavy cold rolled steel . . . self-locking . . . cannot strip or loosen . . . able to withstand abnormal pressure, stress, strain and vibration . . . easier to use in hard-to-get-at places . . . quickly attached or removed without disconnecting the line.

A single length *Universal* Clamp fits hundreds of diameter sizes.

CENTRAL EQUIPMENT CO.

900 SO. WABASH AVE. CHICAGO 5, ILL.



Power Steering

(Continued from page 28)

proximately 160 F, using the recommended oil.

The speed of steering is usually indicated as the number of seconds to swing the front wheels from axle stop to axle stop. We can assume an 80 deg angular swing of the front wheels, or approximately 40 deg each side from center. Experience with power operated gears indicates that for passenger cars a 4-sec swing from stop to stop is satisfactory. This works out at 20 deg per sec angular velocity. The larger vehicles have satisfactory steering with a 6 to 8-sec swing. This works out at 10 to 15 deg per sec. The size and type of the vehicle will determine the selection of steering speeds.

The vehicle maker is concerned with the amount of power used to drive the pump. The largest pump now furnished has a volumetric displacement of 1.25 cu in. per revolution. This pump at the maximum 1000 psi requires approximately 2 hp at 500 rpm, or a torque of 212 lb in. This torque remains substantially constant throughout the speed range. If the pump were required to deliver 1000 psi at 2500 rpm, 10 hp would be required. However, high pressures are not required at high speeds; consequently, the power absorbed is nominal. At high speeds the pump must force the oil through the piping and valve ports and also furnish pressure for whatever power assistance is required.

One typical motor-driven pump employs a constant speed motor rated at 1 1/4 hp at 1800 rpm. This motor is capable of momentary overloads applied during heavy steering. The motor drives a pump of .365 cu in. per revolution displacement and weighs with pump 85 lbs. There are some newly-developed high-speed motors of smaller size that offer attractive possibilities. A recent installation gives a combined motor and pump weight of 24 lb operating at 2500 rpm with displacement of .162 cu in. per revolution. However, with the motor-driven pump,

(Turn to page 104, please)

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.. for over 40 years
**THE PIONEER
MANUFACTURER OF
AUTOMATIC CHUCKING EQUIPMENT**
POTTER & JOHNSTON MACHINE CO.
PAWTUCKET, RHODE ISLAND

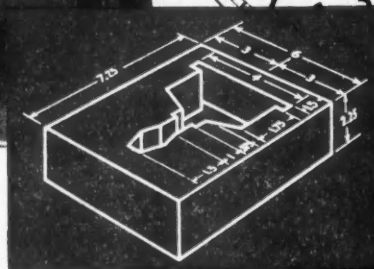
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Designers, layout men, drawing checker, mathematician. Jobs immediately available for men to work on high output aircraft engine. A long-range project of a rapidly expanding department of an old established company. Excellent post war future. Only men with aircraft engine experience can be considered. Statement of availability required.

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Why not investigate the possibilities of the Buell Air Compressor for your Post War Production. The many ways in which it can serve your needs may surprise you. Thousands are in active service in Canadian fighter and bomber planes. Their precision workmanship, demanded in aviation products, assures long service without frequent parts replacement. Designed for compactness and light weight, they will fit into surprisingly close quarters.

Put Air to Work!
It is Clean, Powerful
and Reliable!

Write us, advising all details as to volume and pressure, etc., and our engineers will gladly aid you in solving your problem. We specialize in small, high speed compressors of the highest quality.

BUELL MANUFACTURING CO.
Dept. AA 2975 Cottage Grove Ave., Chicago 16, Ill.

the extra tax on the generator and battery must be provided for. Here again the motor is turning over a great part of the time without any loads on the pump other than friction in the lines and valve ports.

Having determined the speed of steering, we can readily find the amount of power required to operate the steering gear in the various capacities. Fig. 10 shows the power required to swing the front wheels with a torque range up to 6000 lb-ft. The lines 1, 2 and 3 indicate the horsepower required at 20, 15 and 10 deg per sec, respectively. These calculations are based on 100 per cent efficiency and must be modified to take account of certain losses which occur in the transformation of the oil flow to the turning effort on the front wheels.

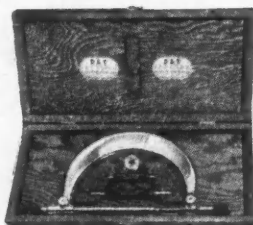
While the power unit can take over as much of the burden of steering as the designer wishes, the torque which the driver exerts on the steering wheel is usefully added to the steering effort supplied by the power cylinder. As an example, assume the driver pulls a maximum of 60 lb on the wheel rim, with a 22 in. steering wheel and 30 to 1 ratio. With 75 per cent mechanical efficiency, 1240 lb-ft effort is obtained at the Pitman arm from the driver. In order to produce this amount of torque, the driver must exert 1630 lb-ft due to the friction loss in the steering. If the driver were able to exert this force at the rates indicated for satisfactory power steering, then they would correspond to the points A, B and C on the graph. No attempt will be made to evaluate the rate of manual power output that can be maintained during the swing of the front wheels. The position is somewhat awkward and even the most sanguine would hesitate to suggest a greater output than $\frac{1}{2}$ hp. This corresponds to the point C on line 3. This represents the maximum practical output that can be expected from the driver. It is one thing to indicate the maximum output and it is another to realize the fact that the driver would be very happy to be relieved of this burden. For matters of comparison, it appears reasonable to assume that the average driver can exert a pull of 30

(Turn to page 106, please)

D & T MICROMETERS AND SNAP GAGES

Tubular welded frames with forged ends insure a maximum of accuracy with a minimum of weight.

There are a variety of types available with either micrometer heads or dial indicators to cover a range of capacities from 0 to 168 in. . . Write for Bulletin 200 or outline your gaging problems.



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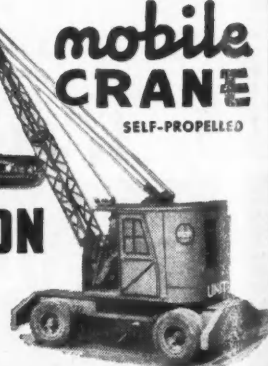


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FOR ALL METAL WORKING OPERATIONS

Jessop Steel Company manufactures a complete line of quality tool steels, suitable for every need. Whatever requirements your application demands, you will find a Jessop Tool Steel available with the characteristics necessary for satisfactory performance.

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Following is a list of Jessop Tool and Die Steels, all available from warehouses or mill:

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Supremus	18-4-1 Type
Supremus Extra.....	18-4-2 Type
Purple Label.....	18-4-1 + 5% Cobalt
Purple Label Extra.....	18-4-2 + 8 to 9% Cobalt
Mogul	Molybdenum
Mustang	6-6-2 Type
Mustang Special.....	6-6-2 + 5% Cobalt

Malta.....Carbide Tipped Tools
T & V.....Cast Alloy Cutting Tools & Dies
Precision Gauge Stock

Consult the nearest Jessop Representative, or write direct for complete information on Jessop Tool Steels—also:

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Magic Chisel	Shock-Resisting
Top Notch	Shock-Resisting
Rapid Finishing.....	Semi-High Speed
R. T. S.....	Extremely Tough

SOLID STAINLESS STEELS • STAINLESS-CLAD STEELS • COMPOSITE TOOL STEELS • HOLLOW & SOLID DRILL STEELS • ALLOY SHEETS & PLATES • CAST-TO-SHAPE TOOL STEELS • MUSIC WIRE

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Dica Series.....	Die Casting

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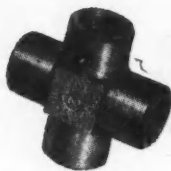
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Established 1901

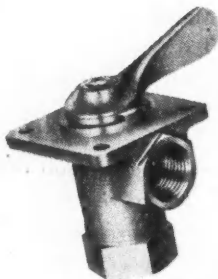
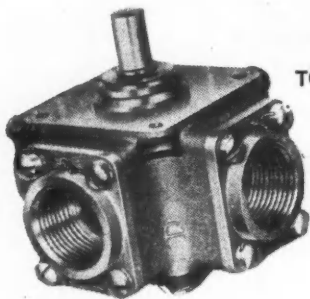
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In addition to an extensive line of valves and fittings for almost every aircraft need, engineering

services are available for help in the design and development of new devices of similar nature.

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Established in 1898

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LOS ANGELES

lb on the wheel rim without serious effort or complaint. This reduces the figures by one-half and the points *D*, *E* and *F* indicate this reduced driver output.

The chart illustrates the amount of power to be furnished by the oil. By making various allowances for the friction losses, we may say that the largest vehicles to date call for a combined power of something in the neighborhood of 2½ hp to give satisfactory steering. Of this power, the driver can be expected momentarily to furnish from ¼ to ½ hp, and the oil to furnish the balance. Perhaps this graph will give an indication of the points of limitation between hand and power steering, but it is too early in the development of this subject to draw any conclusions.

With the oil flowing continuously through the valve ports, it is evident that a certain amount of back pressure exists at all times, depending on the valve port area and shape, the velocity of oil flow and the viscosity of the oil. If we have excessive back pressure, it results in heating the oil and power losses. Here is where we have to balance between valve sensitivity and back pressure; because when we decrease valve port opening we increase back pressure. For passenger cars an upper limit of 50 ft. per sec through the valve ports and a maximum of 20 ft per sec through the oil lines keeps the oil temperature and power consumed within reasonable limits. For larger vehicles, where increased pump capacity is used, we advise considerably lower oil velocities (about 30 to 50 per cent less). Intake line velocity between pump and tank should be kept below 5 ft per sec. This involves placing the two units close together and with as few bends in the lines as possible.

Tests indicate mechanical efficiency of the power system of approximately 85 per cent. This remains fairly constant throughout the pressure range and is the relation between the indicated force exerted on the piston and the actual force delivered at the front wheels. The friction losses occur in the piston and piston rod and the yoke or slides that moves the cross shaft.

(Turn to page 108, please)

Tool Designing Engineers

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Statement of availability required.

The **Spring** OF LIFE

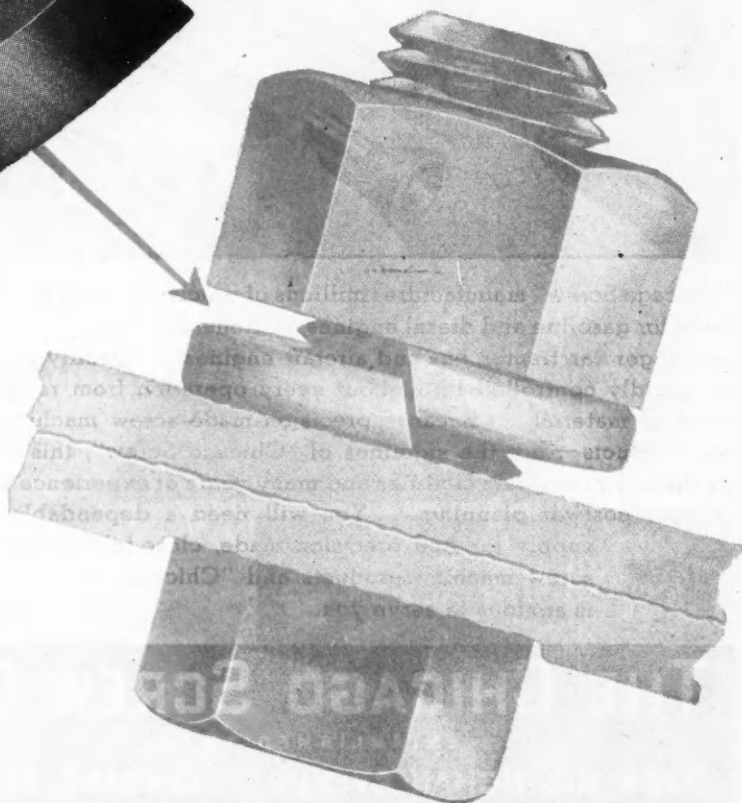
**FOR ALL
BOLTED
ASSEMBLIES**



Wherever metal touches metal there is inevitable wear. Vibration loosens all bolted assemblies. That's why you must use a powerful wide-range spring washer to retard initial wear, and then to expand and hold tight all parts of your assemblies.

The nut never budes on the bolt when there is the slightest pressure on the threads; it's the other parts that need the spring of life. Kantlinks are springs of life to all bolted assemblies.—There is no substitute for a long-range spring washer.

Let us send you samples—send details of your application. Test and compare them on the same job with any type of nut, or with any other type of washer.



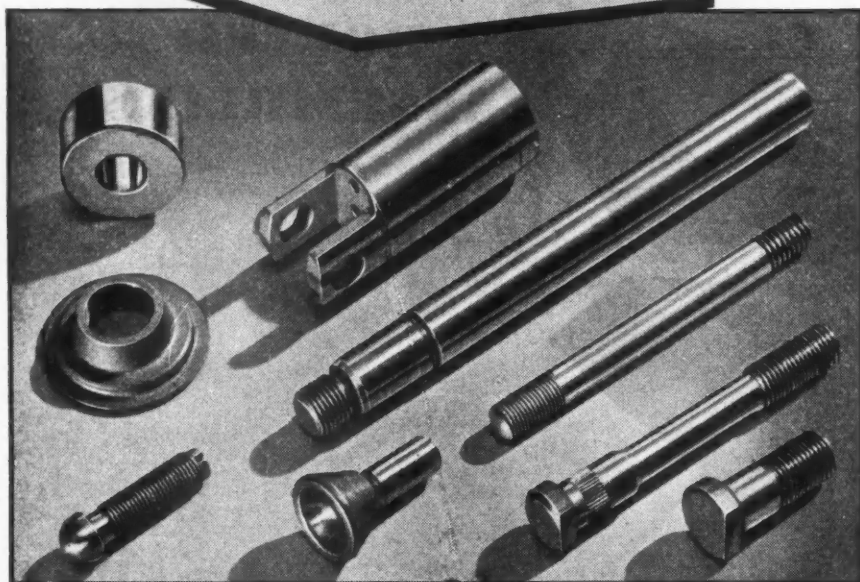
Our Kantlink Spring Washers conform to Ordnance Standard Specification BECX 1-2-3-, and Army-Navy Aeronautical Standard AN 935, and U. S. Navy drawing 12-Z-22.

Originators of **KANTLINK** the long-range spring washer

NATIONAL LOCK WASHER COMPANY

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supply for fine precision-made, close-tolerance screw machine products and "Chicago Screw" is anxious to serve you.



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The other friction losses are in the steering linkage and king-pins. Lavish use of anti-friction bearings in the last two items will reduce the overall friction, but with power actuation of the gear this is not necessary.

Problems of Application

The factors influencing the choice of a power steering unit naturally vary with the application, but certain general considerations may be mentioned.

In favor of compressed air are the facts that:

1. The compressed air system normally supplying brakes and other controls may also be used for the steering gear, thus avoiding the cost and problems of mounting oil pumps and related items.
2. In case of leaks, there is no loss of an expensive working fluid.

In favor of hydraulic gears are:

1. A substantially non-compressible fluid which should give more accurate and positive control.
2. Smaller units due to higher working pressures.
3. Inherent lubrication of working parts.
4. Absence of troubles due to moisture and freezing of same.

If a booster type of gear is chosen, it should, in general, be easier to adapt to an existing vehicle. Road shocks will be transferred directly to the frame. On the other hand, the integral designs are compact and completely housed. There are fewer exposed parts subject to injury and wear. There are fewer difficulties with mounting and alignment. There are no moving hose lines and no exposed lubricating points.

Table I gives the relationship between weights and power output of the various gears on which information is available. The boosters have to accommodate to manually operated gears and require mounting brackets; consequently, the weight of the manual gear must be included with the booster in order to make comparisons with the integral types. In the larger capacities, the manual gear weights run from approximately 75 to 100 lb.

As far as space is concerned, the use of power steering can offer some awkward problems to the manufacturers, as the necessary clearances may not be available without considerable rear-

(Turn to page 110, please)

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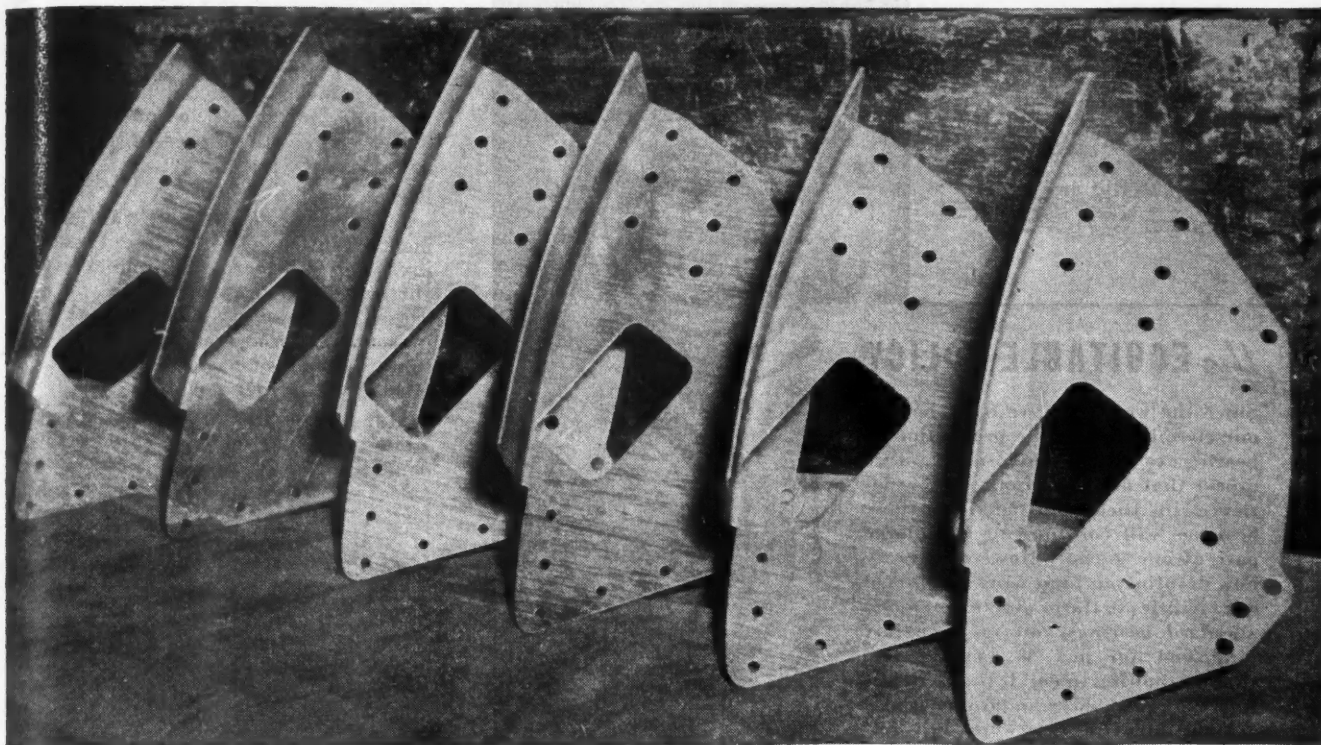
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Above: Aluminum-alloy airplane parts after heat-treatment at Markel Electric Products Co., Buffalo, N. Y. Right: Pedal frame assemblies after heat-treatment and sand blasting. Center: Operator feeds pedal frames to box furnace, controlled by Duration-Adjusting Type ("D.A.T.") Controller at left. Bottom: Operator examines salt pot temperature record on the Micromax chart.

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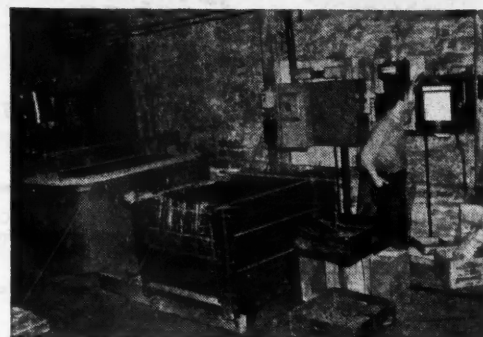
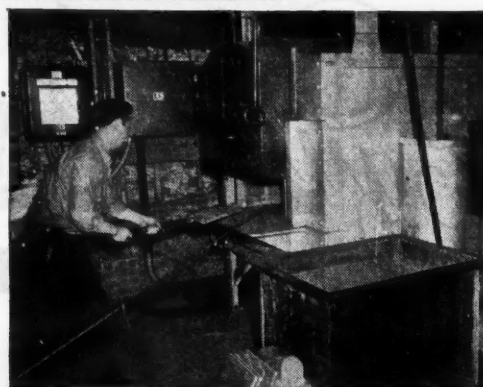
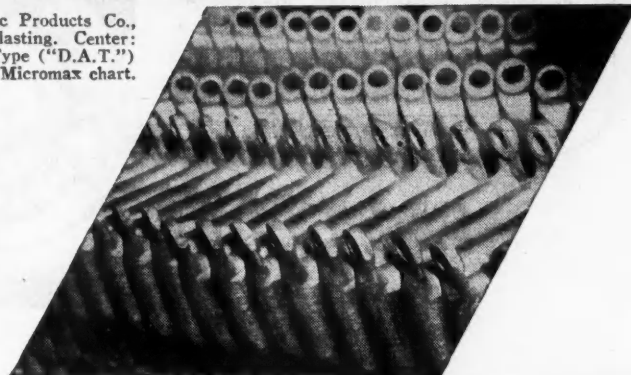
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range of existing parts. Furthermore, the location and drive for the oil pump is a problem, especially where the pump is engine driven. Some existing vehicles are not difficult to modify sufficiently to accommodate the power gears; others present many difficulties in trying to get the units in place.

It is much too early in the development of power gears to present cost figures, for with increased production and further design improvements, we may reasonably expect lower costs. The present gears are considerably above the often quoted basic figure for automobiles of 30c per pound.

Many oil pumps that are used today, while fulfilling performance requirements, are not acceptable from the noise standpoint. After studying and testing the pumps available a number of years ago, the author developed a special type of gear pump that is non-trapping and gives a uniform oil flow, in order to secure the necessary quietness. Cavitation is another item that must be considered in the hydraulic circuit. It is a characteristic of oil and other liquids that, under certain conditions, the flow may be interrupted or accelerated in a manner to cause cavitation. This is evidenced as noise and is thoroughly objectionable. Oil pumps are subject to this condition under certain critical speeds and operating conditions. Where pump speeds get into this range, we must do something to prevent the resulting cavitation. The author accomplished a solution to the problem in the case of a power steering application, utilizing pump speeds up to a maximum of 8000 rpm by means shown in Fig. 11. The return oil, before entering the pump body, flows through a venturi or restricting nozzle, thus adding velocity to the oil stream at the cost of a slightly higher back pressure on the delivery side of the pump. The throat of the venturi is connected to the supply or make-up tank which, in turn, is open to the atmosphere. Thus the oil stream at the point of maximum velocity is at atmospheric pressure. The slowing down of this oil as it enters the pump

(Turn to page 112, please)

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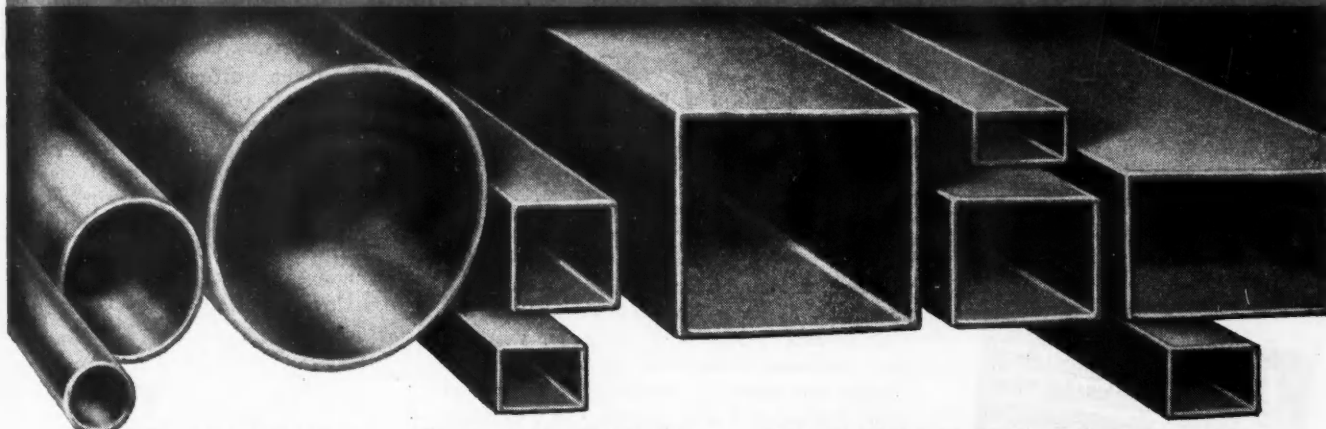
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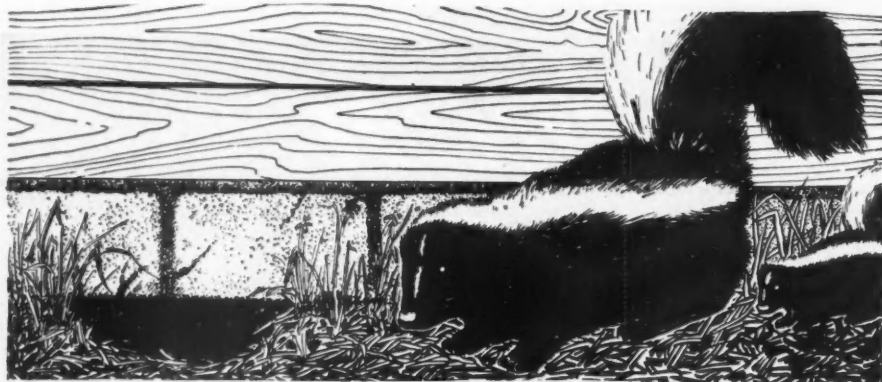
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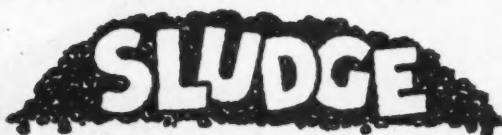
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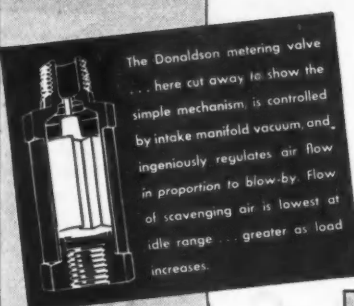
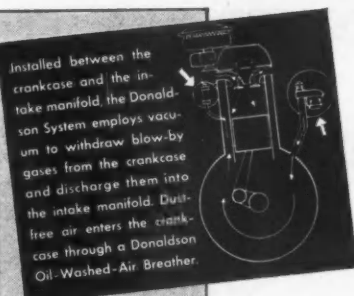


It's the blow-by vapors of water and raw fuel that react with oil in the crankcase to form sludge . . . sludge that cuts oil and engine mileage, makes engines sluggish and hard to start . . . causes oil freezeup in winter.

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body adds increased static pressure and thus supercharges at a pressure above atmospheric. This effect increases with pump speed, thus taking care of the increase in periphery speed of the pump gears.

Another condition that must be guarded against is aeration of the oil. Provision must be furnished to bleed the system readily on initial filling and to maintain the oil free from air; otherwise, a spongy action results and the pump becomes noisy. The reservoir must not permit cascading and consequent trapping of air. Leakage must be kept to a minimum, both to obviate continual filling of the oil tank and to avoid the expense and messiness involved. Excessive heating of the oil through restrictions in the control valve or tubing must also be avoided. A maximum working temperature of 160 F is satisfactory. Higher temperatures lead to increased pump slippage and are generally undesirable.

There is no uniformity in the kinds and grades of oils recommended with the hydraulic systems. Some advocate special hydraulic oils, while others advise the use of motor oils. It is evident that atmospheric temperatures will determine the grades of oil used. An oil must pour at below the starting temperature; otherwise, trouble can result through speeding up of the pump before circulation starts.

MEMA Appoints Four On Show Committee

At its recent meeting, the board of directors of the Motor & Equipment Manufacturers Association, preparing for the resumption of the Automotive Service Industries Show when conditions permit, unanimously ratified the appointment of the following members as its representatives on the M.E.M.A. section of the next A.S.I.S. joint operating committee: J. M. Spangler (Ch.), National Carbon Co., New York, N. Y., R. D. Black (V. Ch.), Black & Decker Mfg. Co., Towson, Md., C. P. Brewster, K-D Mfg. Co., Lancaster, Pa., and Fred G. Wacker, Automotive Maintenance Machinery Co., North Chicago, Ill.



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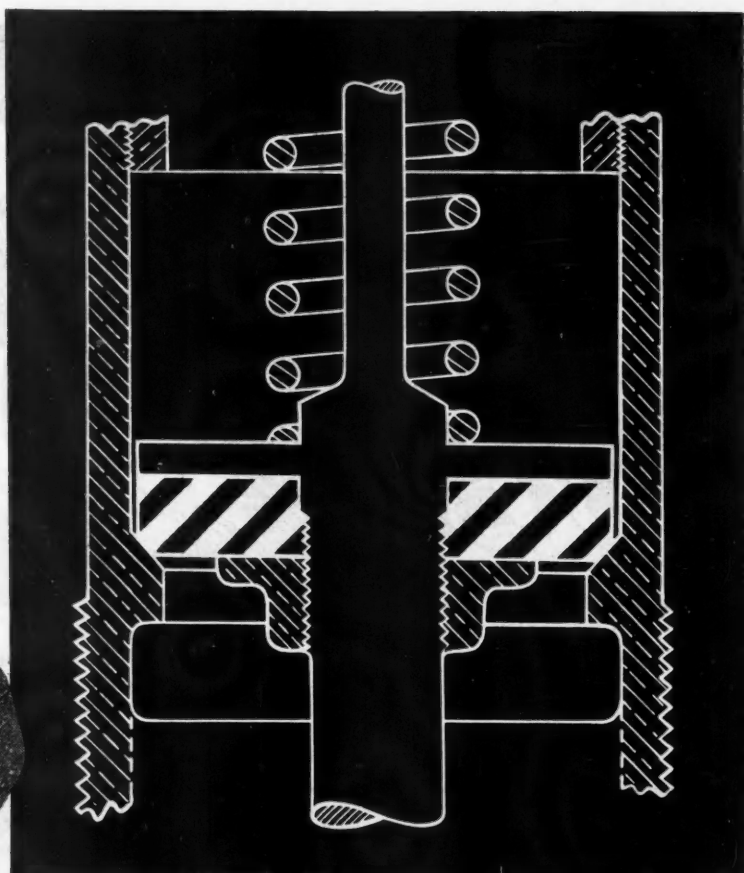
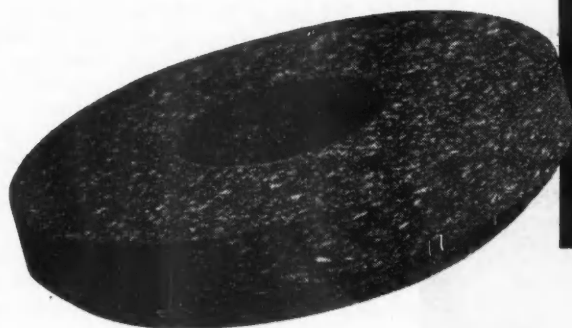
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Forging Crankshafts

(Continued from page 18)

ings was quite satisfactory as the two blows in the fuller, turning the stock 90 deg between, had disposed of the scale nicely. Controlled atmosphere furnaces or hydraulic descalers would, of course, further enhance surface finish.

Dimensionally, the forgings were satisfactory, but the use of a heavier capacity, more rigid press, such as would be installed for regular production on crankshafts, would undoubtedly make it possible to hold the forgings to closer tolerances. With suitable ejectors, draft probably can be reduced requiring less metal to be removed in some locations, thus saving machining. Other crankshafts were experimented with and the results were substantially the same as the above.

Where a bender was used it was found necessary to increase the humps and valleys, as evidently the slower die speed of the press did not shoot the stock up as far into the bends as the higher velocity hammer blows. Slight modifications on the bender dies, however, brought the stock into the right position to fill the finishing impressions.

The press, because of its solid frame rigid against "egg-crating" or sidewise deflection, and its ram with long guide bearings to prevent cocking, is not damaged by off-center fullering and bending operations. Production will run considerably higher due to the fewer number of blows required to produce the forgings, and the greater simplicity of operation will demand less effort and skill on the part of the operating crew.

Savings are said to result from press-forging crankshafts in proportionally greater degree than in the production of transmission and differential ring gears, steering knuckles, knee action arms and numerous other automobile forgings that have been press-forged in large quantities in automotive forge shops.

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